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Engineering News-Record

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February 9, 1928

Concrete Wall Cut in Sections and Moved 1,000 Feet

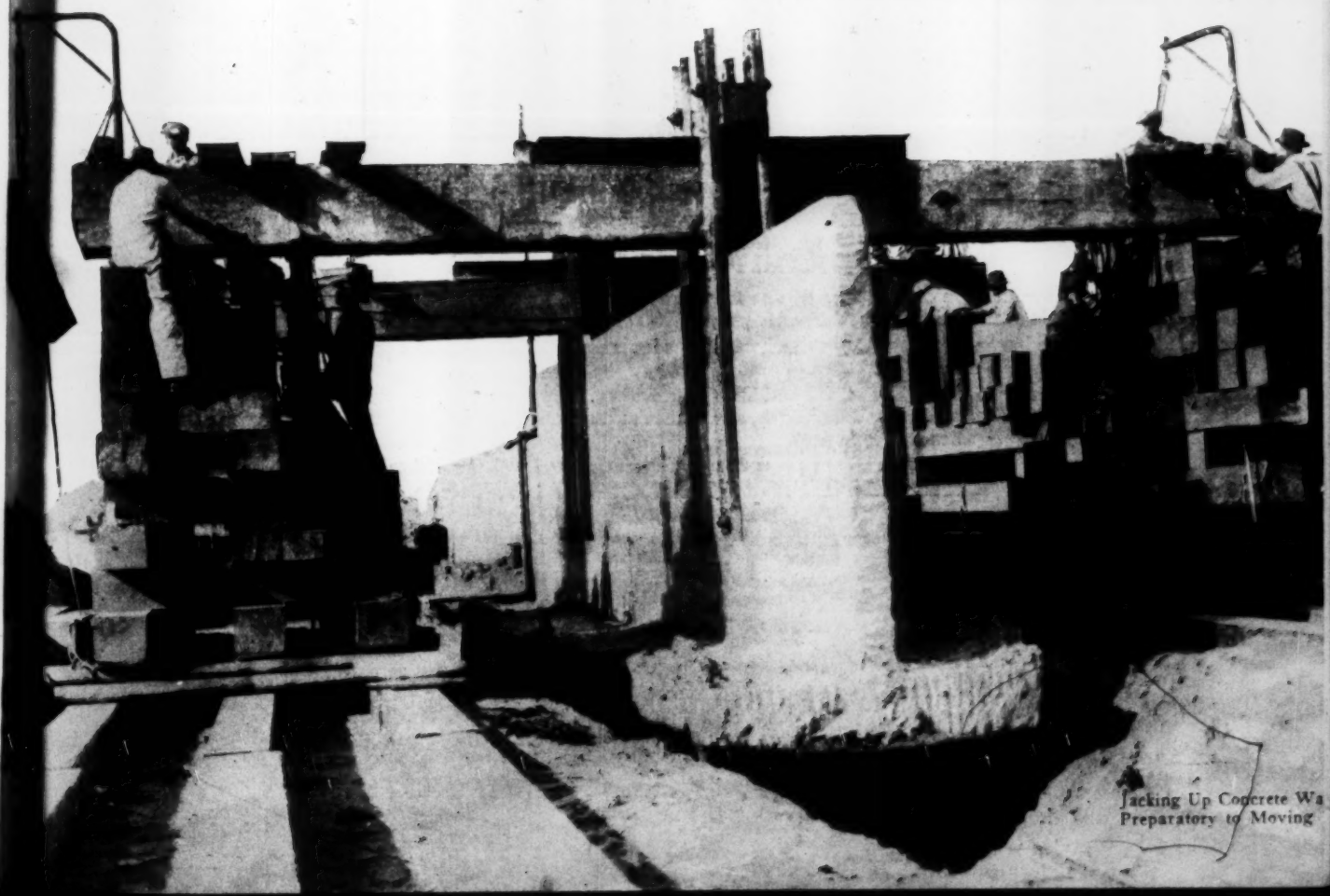
Concrete Lining Plant for Cascade Tunnel

Three-Track Car Ferry Landing for Wabash Railway

Signals for Highway Intersections

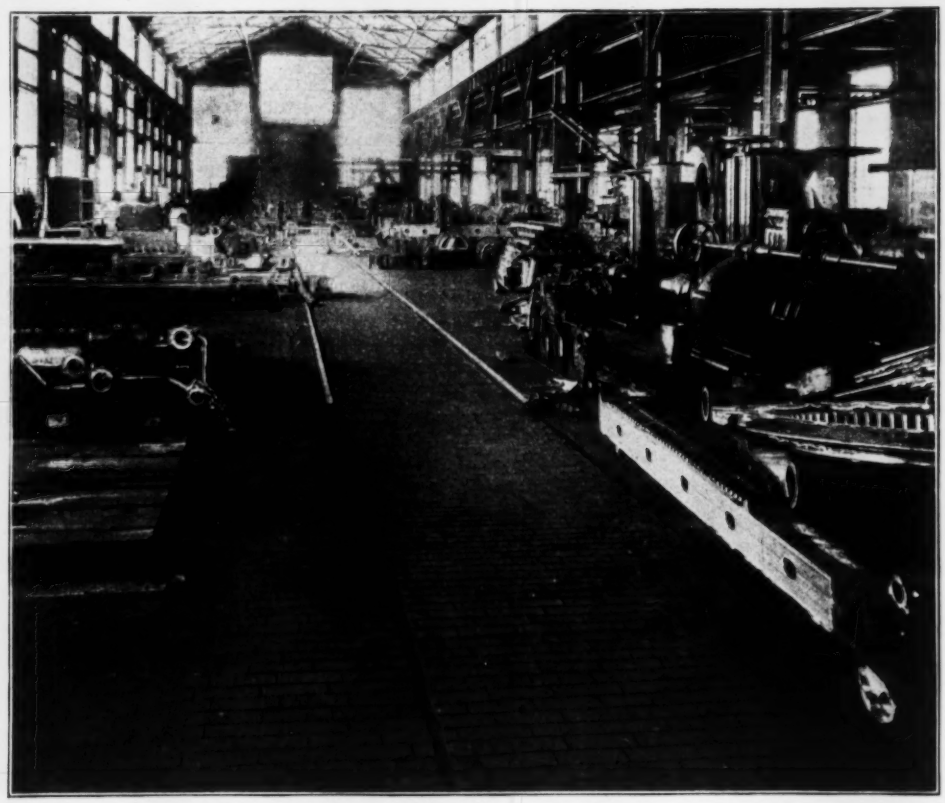
Asphaltic Concrete Paving Practice in Denver

Deep-Pit Sewage Sludge Digestion at Indianapolis



Jacking Up Concrete Wa
Preparatory to Moving

KREOLITE



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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

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General Manager
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Managing Editor

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The Return of the Iron Horse

YEARS ago the coming of the first railroad train was the cause of great rejoicing. To any community it meant cheap and dependable communication with the outside world. But with the passing of years and the recurrence of petty annoyances common to any utility with which man has daily contact, the real value of railroads has been forgotten. There have been those who even advocated pulling up railroad tracks altogether. Northern Vermont was no different in this respect than other parts of the country when, in a few hours last November, floods swept away bridges and track of the Central Vermont Railway and left many towns without any railroad communication whatever. But last week, when after prodigious effort the line was again opened for traffic, there was a different atmosphere. In the intervening three months the people of those Vermont communities had come to a new understanding of the railroad. The automobile, motor truck and motor bus had all proved useful, but they could not supplant the railroad. As the first train moved over the reconstructed tracks of the Central Vermont Railway it was welcomed joyously everywhere. Towns were decorated for the occasion and the larger cities brought out their bands and gave the railroad officials a formal welcome. Once more the whistle of a locomotive echoing through the valleys of northern Vermont was a welcome sound. It told the people that they no longer were cut off from the outside world. And to the world it announced that Vermont has recovered from the staggering blow dealt it by the floods of last fall.

Boulder Dam Advances

A FIRST step forward has been made by the Boulder Dam project, through the House committee's approval of the Swing bill a few days ago. The action was taken under an unusual limitation, however. So far the states of the Colorado River basin have not come to agreement on their respective claims to the river, and therefore the plan to make flow regulation subject to the Colorado River Compact has remained illusory. As we have previously reported, the bill proposes to simplify this part of the problem by requiring that only six of the seven states need agree upon a compact, though it is difficult to see how this would obligate an unagreeing state. It also proposes to recognize in advance any future agreement on water and power rights that may be arrived at by the lower states—Nevada, Arizona and California. Possibly the complications inherent in this latter provision were evident to the committee, for it decided that the bill shall not be brought to a vote in the House for a month or more, in order that the basin states may have time to formulate an agreement. Whichever way this plan works out, the bill has many hurdles to surmount, and there are apt to be interesting times before it gets through House and Senate. It is expected that opposition of power interests will be less of a factor this year than last, but the conflicting demands of the states along the river are sufficient material for much animated discussion. In addition, it should not be forgotten that the nation has an even larger stake in the project than any of the states, as expressed by the proposed investment of $100,000,000 or so of national funds in the project.

A Case of Nerves

TECHNICAL discussion is no place for controversy or recrimination, especially in so weighty a matter as Mississippi River flood control. Accordingly it is surprising to find that General Jadwin closed his testimony before the flood-control committee of the House with a scathing attack on the Mississippi River Commission. He charged that the commission had to be prodded into preparing a definite plan of flood control and that the plan which it did finally prepare was "full of holes" and had "glaring defects." The statement was not made on the unguarded impulse of the moment, but was written and mimeographed in advance. Personal attacks are especially weak in this case; they do not help to decide the technical question of whether the commission or the Chief of Engineers has the sounder plan and the more dependable estimate. Its apparent object was to discredit the commission as an agency for handling the Mississippi work and bring about a transfer of the work to the Chief of Engineers. If the commission is to be discredited by so unprofessional a proceeding, it would be well to investigate the facts pro and con, incidentally bringing to light how and why the Chief of Engineers attempted to cause the commission to report conclusions against its own judgment. The present circumstances, which have led the commission's plan of conducting the future flood-control work to have rather general preference, make it important that the professional reputation of the present commission should not be undermined by invective and accusation.

More Politics at Chicago

BY ITS recent reckless interference with municipal technical departments, with resulting detriment to the public welfare, Chicago has placed itself in a class with Baltimore and St. Paul. Having summarily replaced a highly efficient health commissioner by the mayor's private physician, a man without public health training, later it suspended and last week it discharged A. E. Gorman, chief sanitary engineer. In reality this was a political move, but ostensibly it was because in making the city's water safe by chlorination during a period of exceptional pollution the water necessarily became offensive in taste, as recorded in our issue of Jan. 12, 1928,

p. 90. Without warning, his superiors requested Mr. Gorman's resignation, and on his offering protest, he was advised that his removal was an "administration measure"—that is, a political deal—and therefore his civil service rights would not be of much help. He was given about half an hour for his decision. However, as resigning would appear to admit that he was in the wrong, Mr. Gorman refused to take this step, so that "charges" against him were filed with the civil service commission. The flimsiness of these charges appears from Mr. Gorman's reply to them, printed in the news pages of this issue. Mr. Gorman's record and experience are such that this political attack will not affect him in professional circles, but nevertheless the action is an injury to him. It is also an injury to the engineering profession and a blow to efficient municipal administration in Chicago and throughout the country.

A Railroad Station Without Rails

A PASSENGER terminal unique in railroad history is that which the Baltimore & Ohio Railroad is establishing in New York City. The company has taken the greater part of the ground floor of a new building that is being put up on 42nd St. opposite part of the area occupied by the Grand Central Terminal and is establishing therein a station for the convenience of its passengers which is far from the actual terminal where its trains come into the metropolitan area. Baltimore & Ohio tracks now come into the metropolitan area over the tracks of the New Jersey Central to its terminal at the waterfront in Jersey City. From this point, for some months past, the Baltimore & Ohio has been running buses to and from the Grand Central Terminal area. This arrangement has been found so satisfactory that the company now is establishing a permanent terminal in that region by making provision, in a building now being erected, for the accommodation of buses operating between that point and the Jersey Central Terminal. This is a new solution of the great problem of delivering passengers in the heart of the city. It is feasible so long as the number of passengers is not large.

Reorganizing Backward

IN SPEAKING of the movement to reorganize the federal public works, a few weeks ago, we suggested that attempts at wholesale consolidation of functions evolved by definite service needs are apt to be harmful rather than beneficial. A glaring example of this fact is at present under discussion in the New York State Legislature, where a bill has been introduced that would virtually destroy the department of the state architect by making him an irresponsible subordinate of the superintendent of public works. As matters now stand, all state building work must be designed and supervised by the state architect. Prior legislation, passed a few years ago and strengthened last year, placed this official as well as the state engineer and the highway department under the direction of the superintendent of public works, a political official who need not be an engineer or have other technical qualifications. But it happened that the law was so worded as to leave the architectural responsibility resting squarely on the shoulders of the state architect, where it manifestly belongs. The bill now under consideration would remove this responsibility and place it upon the superintendent of public works. Such confusion of professional specialization is certain to be destructive. It is in hopeless conflict with the sound principle which requires that professional responsibility, whether architectural or engineering, be placed only upon persons competent and skilled in the particular profession concerned, and be accompanied by adequate authority to assure the carrying out of the responsibility. No doubt every engineer would protest, and rightly, were state engineering to be placed under control of an architect; the essential safeguard of engineering responsibility would be destroyed. Precisely the same protest lies against the paralysis of architectural responsibility by a measure of the kind now proposed in New York State. Whatever merit there may be in simplifying organization and centralizing authority, it cannot be realized by an organization that destroys effective function.

Contractors' Joint Activities

WITH recollection still fresh of the convention work two weeks ago of the Associated General Contractors, a fact and a question stand out clearly in mind. The fact is that today contractors are working together in reasonable harmony in association. The question is: What has association work done for them and what are they doing through association work?

A part of the answer can be gleaned from the latest reports of the standing committees through which the association works. They show tangible accomplishments in accident prevention, in quantity survey, in standardization of contracts and equipment, in corrective legislation and in clearing the way for surety bonding and lien law reforms. They hold out promises of even greater accomplishment by continued work. These, then, are some of the things that contractors are doing through association work. What is association work doing for them? The things already mentioned, of course—but, we think, something more also.

Association has taught contractors to live together, to serve themselves and to do some introspective thinking. One may sense this even in the abbreviated reports of committees that were published in these pages last week. In group insurance, in group quantity take-off, in group safety practices and in group credit arrangements contractors are working together and are serving themselves by taking over activities which others have refused to conduct as sound contracting practices require. In so serving themselves contractors have had to do some thinking about their own motives and practices. Association work has necessitated introspection, and introspection has been good for contractors, as it is always good for an industry, a business or an individual. It has convinced them that it is their job to improve contracting.

At West Baden, time and again in speech and debate the voice that rose highest was one of exhortation to association groups to do things and not one of criticism of others for not doing things. The change is notable from the custom of a few years ago. Then convention discussion of contracting evils consisted largely of castigating others for practices injurious to contractors. There is the spirit and soul of progress in this changed attitude of mind. Organized contracting is still asking associated businesses in construction to work with it in stabilizing the industry, but it is going ahead to create new agencies when the old ones are found intractable. There is in this determined policy a development of very profound significance to engineering construction.

Let us make the point clear. The new activity is not

a gesture. A dozen branches of the national association have established quantity survey bureaus, and the movement is spreading for independence in this way of commercial quantity survey services. As many branches have established group accident prevention and liability insurance arrangements, and the movement is gaining speed. Branches and chapters are adopting standard accounting and depreciation practices for income tax reports. Others are arranging group discounts with chapter guarantee of bills. And mutual surety bonding is seriously contemplated, with assurance of the sympathy of public officials', engineers' and architects' organizations.

In a considerable part these activities represent association incursion by contractors into existing associated businesses of construction. As such they command the attention of the associated businesses that are affected. But the contractors' movement has a broader significance and implication. It predicates a new economic set-up in construction. As such a possibility the present activities of organized contracting deserve consideration by constructors.

A Question of Efficiency

A GENERATION ago peace-time military preparation consisted chiefly of making and piling up great quantities of war supplies in government arsenals. Today that system is an anachronism. War has been mechanized; its tools and supplies number legion, and the full technology of a nation is required to provide them. Nor will the mere accumulation of such equipment over a period of years suffice. Tractors and guns, searchlights and tanks, condiment cans and airplanes can only be made and supplied as the army needs them. The making of war material, in short, has become industry's problem, and the arsenal can no longer be a manufacturing plant.

Not only in war-time, however, is industry's aid required. Even in peace the ingenuity of the tractor builder must be concentrated upon the design of tanks, and of the transit maker upon the delicate mechanism of a machine gun, if any nation is to be assured of its military preparedness. But this is not possible under present laws, and our auxiliary equipment is therefore steadily becoming less fit. A movement for reform has been on foot for some time, but now appears to be blocked.

It was proposed to let contracts for small amounts of military equipment to selected firms, which would undertake to install in their plants a complete set-up of machines necessary to produce a small quantity of the equipment on a war-time basis. For example, a large manufacturer of washing machines was to be given an order for a small number of pistols, sufficient only to check the operating efficiency of the machinery and train his operators. Naturally, the cost of pistols made in this way would be high, and under the present law if a government arsenal is among the low bidders it must receive the contract. Of course, most government arsenals could underbid an industrial plant under such circumstances.

This is a situation that should be altered. The law should be changed to make possible the placing of these "educational orders" throughout American industrial plants. A maker of concrete mixers should know how to alter his plant for the manufacture of one-pounders or the steam shovel builder for the making of tanks. This is not possible under the law as now written. National efficiency demands that it be changed.

Noteworthy American Tunneling

THE description in this issue of the methods and plant for lining the new Great Northern Railway tunnel through the Cascade Mountains emphasizes again the fact that 1928 will witness the completion of the longest railway tunnel in America and the third longest tunnel in the world. With the completion, virtually this year also, of the Moffat tunnel, second in length to the new Cascade tunnel, America assumes for the first time somewhat comparable rank with Europe in long mountain tunnel construction for transportation. Without attempting precise comparison, it may be noted that in speed of advancing heading, American tunnel builders have likewise matched the Alpine tunnel engineers and contractors. At Cascade a record of 1,157 ft. was made in one heading in October, 1926, and a record of 937 ft. in September. The best progress at Moffat in one heading in any month was 777 ft., and for one year, 1925, it averaged 603 ft. a month on each of two headings. These are details which need not be entered into further at present.

The more outstanding indication of tunneling progress in America which the Cascade tunnel affords is that the railways which cross our great mountain ranges are becoming increasingly able to undertake major tunneling operations to lower the level of mountain crossings where once all that could be attempted was to seek the best surface line possible over the lowest pass to be found. On the railway being considered, the Stevens Pass switchback line was the highest attainment considered practicable in 1892. Then in 1900 the first Cascade tunnel, 2.62 miles long, cut down the crossing elevation to 3,385 ft. Now the new 7.77-mile tunnel will reduce it to 2,879 ft. Each change has brought its contribution of decreased mileage, reduced grades and curvature and lessened hazards from snow. Details again will not be pursued, but the major indication is not to be ignored: American railways are entering an era of business and earnings in which long tunnels will more and more be warranted and therefore undertaken to reduce the heights and hazards of our mountain range crossings.

In construction methods this second Great Northern tunnel illustrates, as did its contemporary the Moffat tunnel, the sublimation of mechanical power in modern rock tunneling. Virtually no operation—excavation, hauling and lining—was unmechanized. Transmission of power in its highest developments of electric cable and compressed air line was called into use. Power excavators and concrete lining machines performed the elemental tasks of boring the mountain and of binding the excavation into enduring permanence. Machines were paramount in all tasks.

The concluding reason for which the Cascade tunnel stands noteworthy in tunneling history is that it will be electrically operated, following the trend of planning and practice of recent years in American long-tunnel operation. This is noted particularly in contrast with the decision at the Moffat tunnel to maintain the use of steam locomotives and go to heavy expense for artificial ventilation. Although today American railway tunnels generally are steam operated, it seems a fair conclusion that the new Cascade tunnel in its adoption of electric power is in closer conformity than is the Moffat tunnel with the most advanced planning in the operation of long mountain tunnels.

Traveling Concrete Plants Line Cascade Tunnel

Six Mobile Outfits Combining Chutes, Belt Conveyor, Concrete Gun and Mixer Mix Proportioned Batches and Place Concrete

The Cascade tunnel in Washington, 7.77 miles long, the longest railway tunnel in the Western Hemisphere and the third longest in the world, has been under construction since December, 1925. It is being built by the Great Northern Railway to get a lower grade line at Stevens Pass, formerly crossed by a switchback line and later by the 2.63-mile Cascade tunnel, completed in 1900. The new tunnel is 16 ft. wide and 22 ft. high and is lined with concrete. The rock penetrated is solid granite. Construction from the west end is from the west portal and from crosscuts every 1,500 ft. from a parallel pioneer tunnel extending 5.37 miles to a shaft. The east section of 2.40 miles is being driven by heading and enlargement east from this shaft and west from the east portal. The main tunnel is being enlarged from a 10x10-ft. center heading; the pioneer tunnel heading is 8x9 ft. The driving methods were described and the rates of progress were given in "Engineering News-Record," Nov. 25, 1926, p. 858. This article describes lining methods and plant of unusual magnitude and character.

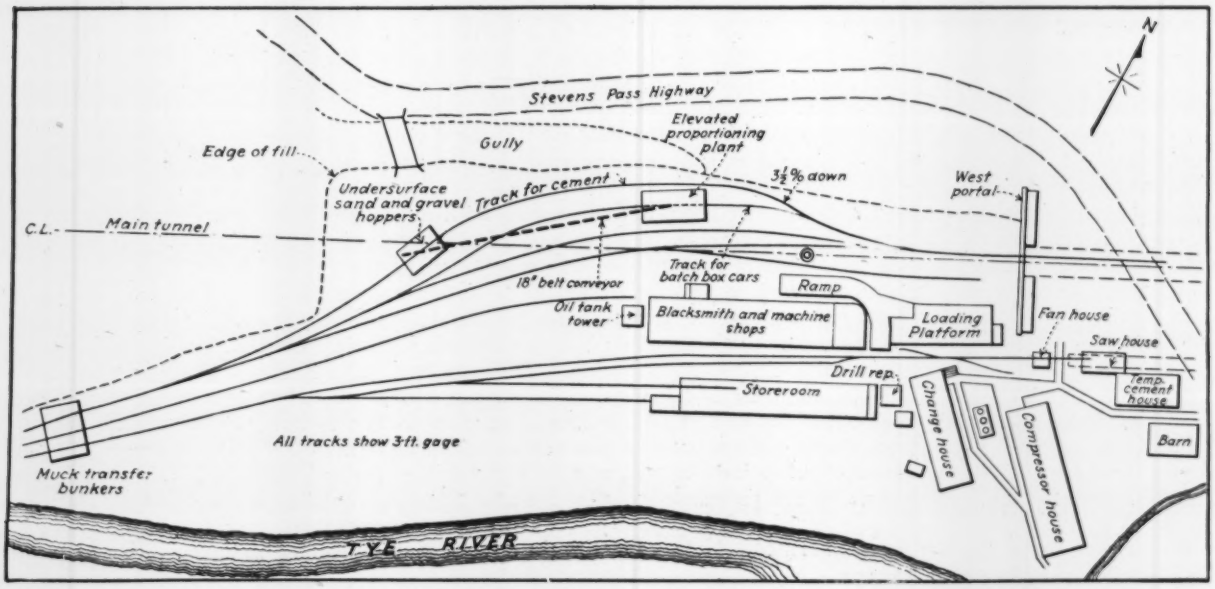
ABOUT 200,000 cu.yd. of concrete has to be placed in lining the Cascade tunnel. Because time is an important factor, the lining operations had to be planned so that they could be started long before the bore was completed. Lining is being carried on simultaneously by six mixing and placing units working at as many different points in the tunnel, three units being served with proportioned batches from each portal. In the operation of these units and of the trains that supply them there is no interference with the muck trains and other equipment moving to and from the headings where driving operations are under way.

The first concrete lining was poured at the west portal on April 27, 1927, and at the east portal on July 22, 1927. On Dec. 1, 1927, a total of about 13,000 lin.ft. of side walls and arch had been placed. Driving in the main tunnel is expected to be completed about Sept. 15, 1928, and, assuming that six concreting units continue to operate, the schedule of the lining operations calls for completion of the lining by Oct. 15, 1928. The section of the lining is indicated in an accompanying illustration. It shows vertical walls and a circular roof arch. The inside dimensions are 16x22 ft. There is no concrete in the invert. The volume of lining per linear foot of tunnel is 4¾ cu.yd.

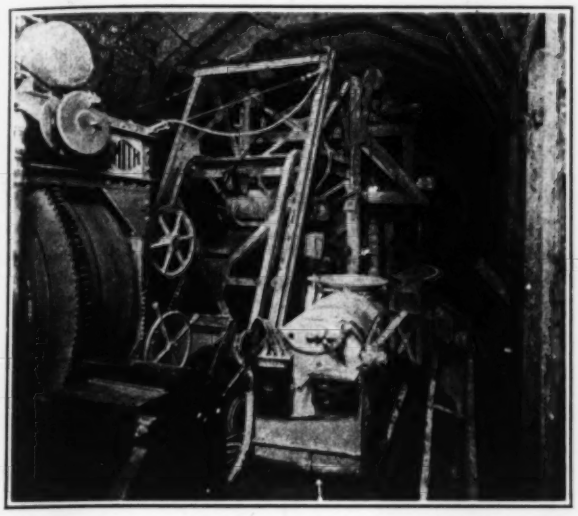
Portal Plants—The first lining plant was set up at the west portal, where a track of 3-ft. gage had already been built from the portal 1½ miles down the canyon to a junction with the main line of the railway. It was decided to use this narrow-gage line to deliver concrete materials from the main line to the tunnel. Sand and gravel bunkers were therefore built, on a main-line spur, into which standard-gage bottom-dump cars could deliver by gravity. The 6-cu.yd. narrow-gage cars, on a track beneath the bunkers, receive their loads by gravity and deliver to undertrack sand and gravel transfer hoppers at the portal of the tunnel. From these hoppers an 18-in. belt conveyor, 175 ft. long, delivers to elevated bunkers in a proportioning plant.

At the east portal a somewhat different situation obtains. The main line passes close to the tunnel portal, so that the transfer bunkers and 6-cu.yd. dump cars were not needed. It was necessary here to build only a few hundred feet of 3-ft. gage track in order to deliver materials into tunnel trains from a cement house and proportioning plant that are served directly by standard-gage spurs from the main line.

Transporting Materials Into Tunnel—The method and equipment used between proportioning plants and the point where work is under way in the tunnel are the same on both east and west ends. In laying out the construction plant it was found necessary to put mixers in the



PROPORTIONING PLANT AND TRACK LAYOUT AT WEST PORTAL OF CASCADE TUNNEL



IN-TUNNEL VIEW OF LINING PLANT, SHOWING CONCRETE GUN

tunnel and to deliver the materials to them in dry batches, because the haul from the portals would approach 4 miles as the work neared completion. This length of haul was considered too great for the delivery of wet concrete, and it was decided to use concrete-mixing plants on steel "jumbos," or high cars, that could be coupled to and moved with sets of steel lining forms. Each set of forms was made 37½ ft. long, this distance being adopted to allow two complete set-ups between adjacent contactor supports in the roof of the tunnel, which are 75 ft. apart. The tunnel is planned for electric operation, using a contactor voltage of 11,000; to provide clearance for the insulators, at each contactor support a dome-shaped recess is being left in the crown of the arch. The recesses are 5 ft. in diameter and 14 in. deep.

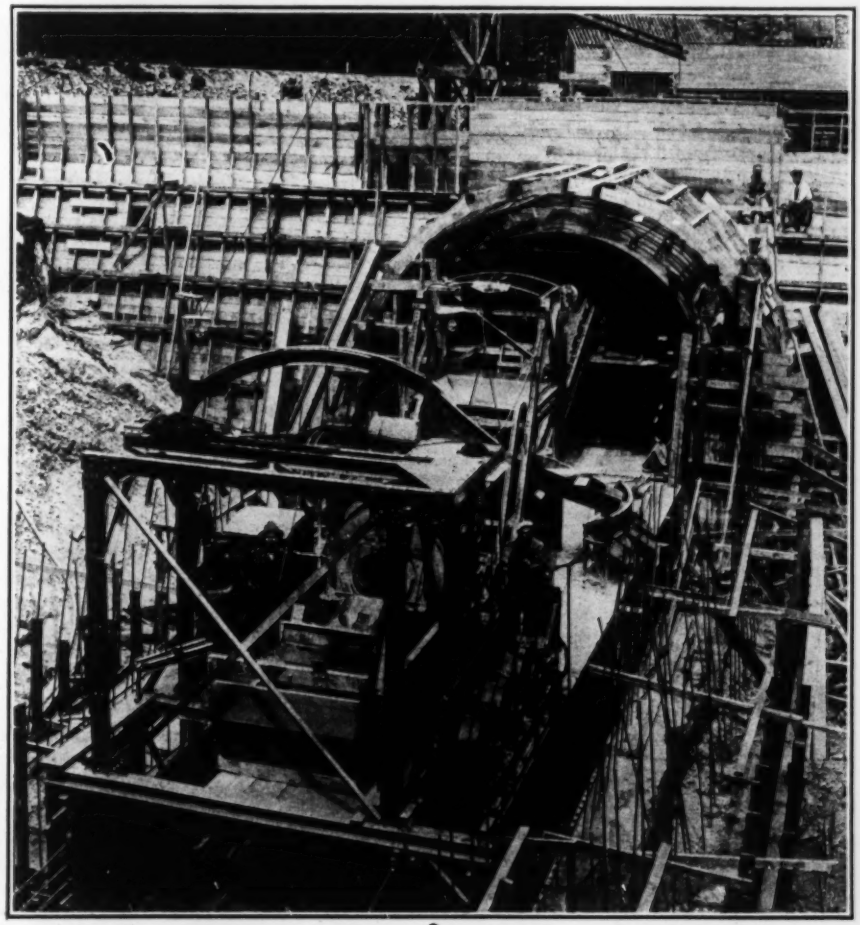
Each unit of steel forms and the attached steel jumbo, carrying concrete mixer, hopper, distributing chutes, concrete gun and one end of the conveyor belt, is arranged so that all apparatus and equipment are supported at a high level, leaving a clearance of 7 ft. 3 in. above rail head for the operation of muck and batch cars. During the construction period two 3-ft. tracks are maintained in the tunnel, thus making it possible, with the aid of a carefully planned dispatching system, to serve simultaneously and without confusion the three concreting units in each end as well as the driving operations at the heading.

The lower part of the tunnel walls on either side will carry conduits for telephone, power and signal wires, and to facilitate accurate spacing of these conduits it was decided to pour the walls up to a height of about 6 ft. in an operation separate from the remainder of the lining.

Mixing and Placing Concrete—The sequence of operations in placing the lining, the same at both portals, is as follows: Sand and gravel are delivered in the right proportions from the proportioning plant into steel batch boxes carried on flat cars of 3-ft. gage. The proportioning plants have volumetric measuring devices on the gravel bins and scale-weighing devices on the sand bins. Cement is measured into the batch boxes by sack. Each batch box has a separate compartment for cement in order that it may be kept away from the wet sand while the batch is in transit. The concrete is 1:2:4 mix and is taken in in ½-cu.yd. batches. The concrete is placed fairly dry, and in order to deliver in chutes as flat as 1 on 5, 2 per cent of diatomaceous earth is used.

Each flat car carries three batch boxes. Trains of eight flat cars are hauled into the tunnel by 20-ton trolley locomotives. Arriving at the mixer, the train is spotted so that the first batch box can be lifted by the air hoist on a small traveling crane that is arranged to move transversely to a position over the mixer skip. Here the batch box is tripped to deliver its contents to the skip, after which the empty batch box is returned to the flat car and the train moves up to bring the next batch box into position for lifting.

On discharge from the mixer the concrete goes into



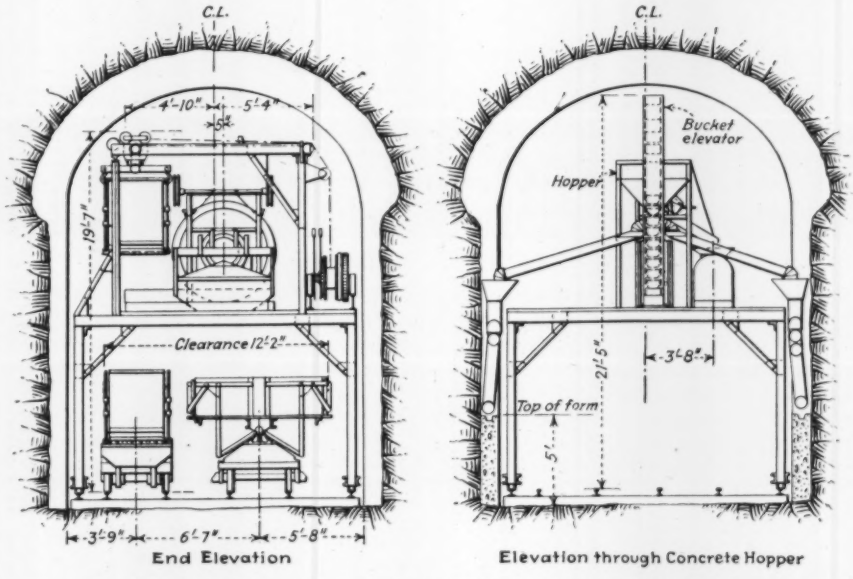
CONCRETE LINING PLANT AT EAST PORTAL

another skip that can be elevated to discharge into a main distributing hopper. Below this hopper a series of gates is so arranged that the discharge can be directed (1) into any one of several chutes for delivery by gravity into the lower part of the wall forms, (2) to a belt conveyor to be elevated and delivered into the side walls at a higher level or (3) into the receiver of a 1½-cu.yd. concrete gun, whence it is shot by compressed air into the crown of the arch.

The gravity delivery directly through chutes serves that portion of the wall forms in which the conduits are placed—namely, to a height of about 4 ft. above the invert. The belt conveyor delivers at a level of 28 in. below the crown of the arch, where concrete is struck off the belt and conveyed by chutes to either side wall, thus raising the walls to the springing line. From the springing line up, concrete is placed with the pneumatic gun.

A crew of about 75 is used to man the three concreting outfits on the three shifts employed in each 24 hours. Of this number about twenty are carpenters used on form work or in setting up and fitting the forms. The three shifts of concrete crews, about ten men on each shift, ordinarily work on different concreting units. In fact, the expense entailed by having three sets of forms and three complete concreting outfits on each end of the job was believed to be justified by the time that would be saved by making it possible to move from one unit to another without interrupting the continuous flow of concrete materials into the tunnel.

Pours are made in three steps on the same day. The first pour is merely a footing, consisting of the one or two feet of wall necessary to bring it up to a level with the top of the traveler rail head. Forms for this pour are made of wood. Weep holes formed by drain tile 37½ ft. apart are put in this part of the wall. Accurately located ¾-in. bolts are embedded near the top of the pour to serve as bottom anchors for forms to retain the next pour above. The forms for the second pour are of steel and are carried in 10-ft. sections on the sides of the steel traveler. When the traveler moves up into position, the bottoms of the form sections are bolted into place and the tops are held between struts to the tunnel timbers and wedges against the traveler frame. In the third pour, forms are set up for all of the remainder of the walls and for the arch. These forms are carried by the traveler in a continuous series of 10-ft. units with a longitudinal joint at the crown of the arch controlled by a turnbuckle. With the aid of this turnbuckle and two others in a horizontal strut 8 ft. above rail head, the forms are made to hinge on the joint along the crown, the two sides being swung in to give clearance for moving or thrust out and held rigidly in the exact position desired when set up for pouring.



SECTIONS SHOWING CLOSE CLEARANCES OF CONCRETE LINING PLANTS

BATCH BOX TRAIN IN TUNNEL SERVING LINING PLANT

When the concreting units first went into the tunnel, they were placed about 1,500 ft. apart and numbered 1, 2 and 3, respectively, with No. 1 nearest the portal. As the work progressed this spacing was maintained until units Nos. 1 and 2 were within about three moves of connecting with lining already in place. Unit No. 3 was then moved ahead and, on finishing its section, No. 2 was moved up to a point midway between the position just vacated by No. 3 and its new location. Unit No. 1, on finishing its section, moved to place where No. 3 left off. By having jumbo tracks laid ahead and all preliminary work done, the units could be moved in about twelve hours without affecting the pouring cycle. The daily move, which consists of releasing forms, moving ahead 37½ ft. and lining up for the next pour, requires an average of eight hours. Concrete is allowed to set 24 hours after completion of pour before forms are removed.

This arrangement and method of operating the concreting units has been entirely successful in that they

have not interfered with the operation of trains to and from the headings. Progress has averaged about 90 ft. of completed lining per calendar day for the three units in each end.

Both driving and lining the Cascade tunnel are being done under the general direction of J. R. W. Davis, chief engineer, Great Northern Company, and under the personal direction of Frederick Mears, assistant chief engineer of lines west. The contract for driving and lining is held by A. Guthrie & Company, Inc., with J. C. Baxter, vice-president, in general charge and W. E. Conroy general superintendent at the tunnel.

Novel Crest Design for Thin Overpour Dams

Lip Projects Flow Beyond Toe, Splitters Aerate Space Behind Water Curtain, Thus Avoiding Vibration

By J. C. Stevens
Consulting Engineer, Portland, Ore.

COMPARATIVELY few dams of the thin arch type have been designed for large volumes of overflow. Where the canyon walls and stream bed are of enduring rock, however, there appears no good reason why arch dams cannot be so designed. The stability of a pure arch dam does not depend upon the load on the stream bed but upon the stability of the canyon walls to which the arch thrust is transmitted. The wearing away of the rock in the stream bed is therefore of secondary consideration as long as it does not wear at the immediate toe of the dam enough to affect the water seal or to weaken the ability of the foundation to support the vertical weight of the dam.

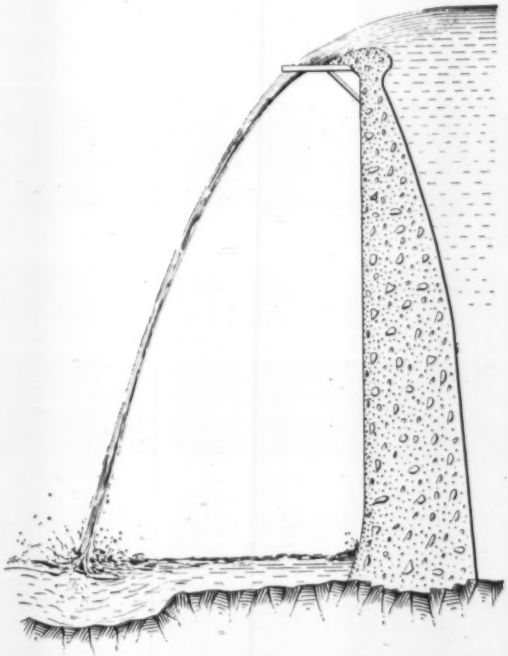


FIG. 1—SECTION THROUGH THIN DAM WITH PROJECTING LIP

The continued overflow of water will in time wear away the hardest rock, although it is often the seamy character of the rock rather than its hardness that governs the rate of wear. Continued wear below a spillway creates a pool and hence a water cushion that steadily slows up the rate of wear as the pool deepens until it ceases altogether. If the overflow can be directed so that the pool is formed far enough below the toe, the stability of the dam will not be affected.

It is important, however, to prevent appreciable wear on the canyon sides. In many dams the overflow is of short duration, and during a part of every season the canyon sides may be inspected and repaired if necessary.

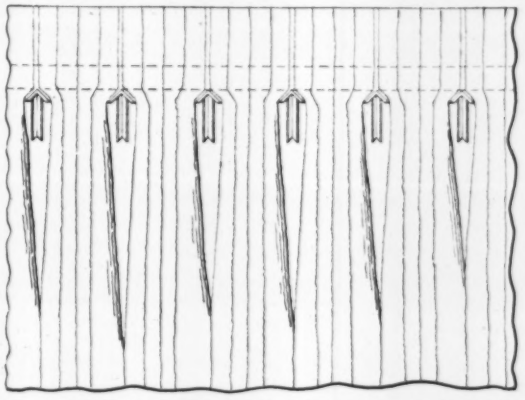


FIG. 2—FRONT ELEVATION SHOWING AIR HOLES THROUGH WATER CURTAIN

Recently while designing a dam the entire crest length of which was required for spillway, it occurred to the writer that the arch type could be used with safety, since the foundations were stable, provided means were taken to project the overflowing nappe as far from the toe as possible.

A lip at the crest of the dam was provided and provision was made for completely aërating the space between the nappe and the dam. For given conditions of height of dam and depth of overpour there is a certain slope to the lip that will project the nappe a maximum distance away from the toe. Complete aëration of the nappe will also prevent vibrations due to building up and suddenly releasing the partial vacuum that would otherwise form between the nappe and the dam. Such vibrations, if continued, must surely be detrimental to the safety of a thin arch dam. The general idea appeared to be novel and the writer applied for a patent.

Fig. 1 shows the maximum cross-section of a thin arch dam having a lip of such slope that the nappe will be projected a maximum distance away from the toe.

In the absence of piers on the dam crest complete aëration is secured by the use of "splitter beams" projecting through the nappe and forming elongated openings in it, through which air may circulate freely, as shown in Fig. 2. These beams are made of heavy angles or of built-up angle-shaped sections.

The projection or amount of overhang in the lip is governed by structural considerations; the greater this is the farther the nappe will be projected. The slope of the lip for a given length to give maximum projection varies with the volume to be discharged per unit width. It is found by trying various slopes until a maximum projection is obtained for the desired rate of overflow. In general, the nappe may be projected so as to strike the stream bed a distance below the toe equivalent to nearly two-thirds the height of the dam.

Three-Track Car-Ferry Landing; Wabash Railway

Counterweighted Balance Beams Carry Outboard End of 63-Ft. Apron—Shore End Is Pivoted on Hinge Pins

By S. M. Smith
Assistant Bridge Engineer, Wabash Railway, St. Louis, Mo.

MANY innovations making for permanence were incorporated in the details of a new landing apron which the Wabash Railway has completed for its car-ferry service across the Detroit River between Detroit and Windsor. For the first time concrete foundations have been used to support the steel structure; pin connections have been provided with bronze bushings, and fittings for grease guns have been introduced to provide for better lubrication. The length of the apron, 63 ft. over all, was increased 10 ft. over the old design and the approach span decreased a corresponding amount, in order to permit of constructing the hinge pier in advance of erection and also to decrease the grade on the apron at extreme high- and low-water levels.

General Description—A layout of this landing is given in Fig. 1. The apron, carrying three parallel tracks, consists of six plate girders 60 ft. long, or 63 ft. including the steel nose castings which engage seats on the ferry boat. About 12½ ft. from the outer end the girders are framed against a transom or transverse girder 44 ft. long, having its ends suspended from the counterweighted balance beams. At the shore end each girder has a 5-in. hinge pin passing through its web and the webs of a pair of 24-in. I-beams 22 ft. 3 in. c. to c. of bearings, forming a shore span. This hinge and the pin-bearing shoe for the I-beam span are shown in Fig. 2.

To secure the apron to the boat, each of the two inner girders has an eyebar pivoted to a casting and carrying a latch bar slotted to drop over a lug on the deck of the boat. Adjustment of the latch is made by filling the open part of the slot with loose steel blocks.

No provision was made for any warp that might come into the apron, it being assumed that the girders were sufficiently flexible to take any twist that would come to them and that if the structure should be rammed by a boat out of control the impact would be taken up by the bending of the foundation piles of the hinge pier. A sliding joint was provided at the abutment to take up any longitudinal movement due to a boat pushing or pulling on the apron. In case the longitudinal movement should be greater than anticipated, sufficient space was left between the end of the approach span and the backwall to add a set of coil springs if necessary.

The structure was designed for Cooper's E-60 loading, with 50 per cent of the live load added for impact. The Detroit River has a period of average high water during the winter and spring, followed by a period of average low water during the summer and fall months. The elevation of the hinge end of the apron has been so designed that it is adjustable for high- and low-water elevations. By removing three pieces of the hinge shoe casting it can be lowered one foot.

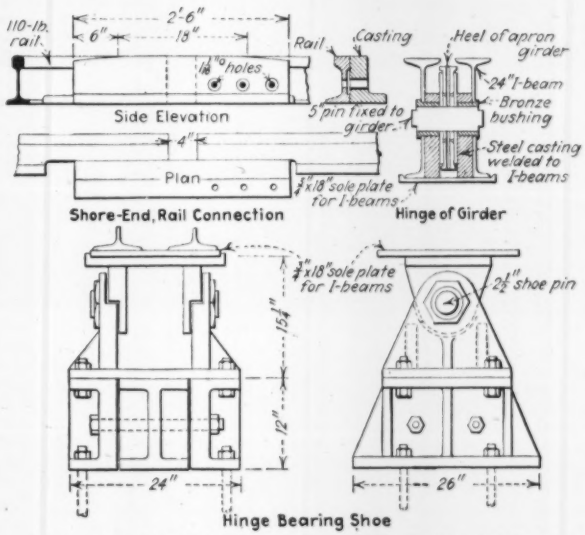


FIG. 2—APRON HINGE AND SLIDING JOINT IN RAIL

Counterweight System—An unusual arrangement in the supports is that the counterweighted balance beams or rocking levers from which the outboard end of the

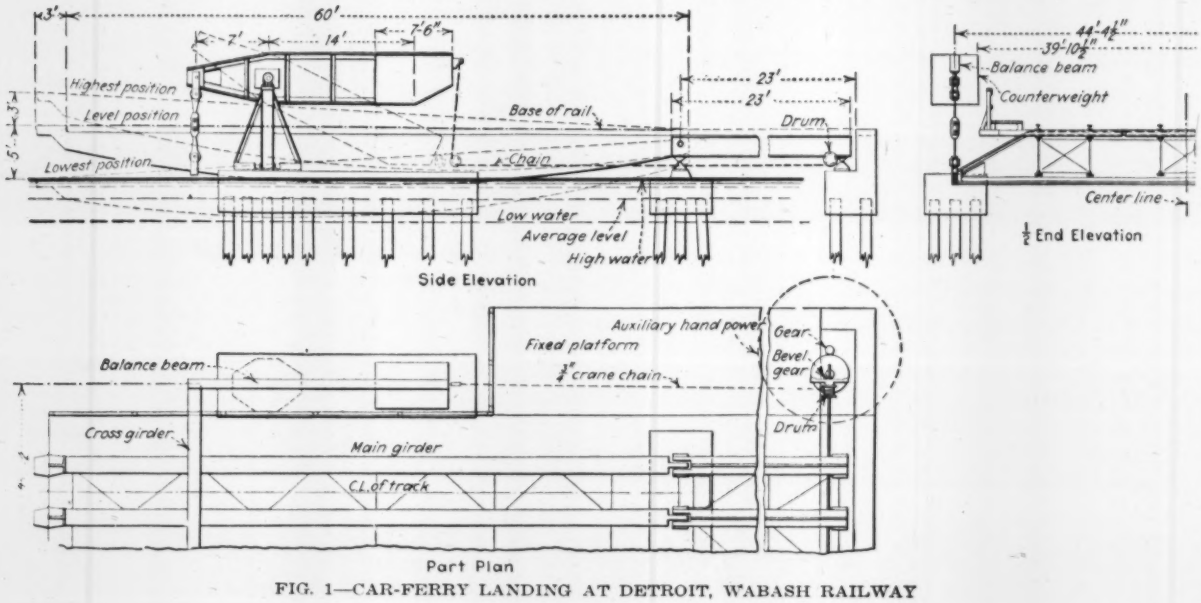


FIG. 1—CAR-FERRY LANDING AT DETROIT, WABASH RAILWAY

apron is supported are carried by steel towers only 8½ ft. high. To make the counterweight box and tower as low as possible, thus minimizing danger in case of derailments, each beam and box was made in one piece. These beams, 25½ ft. long, are pivoted on the tower at 7 ft. from the outer end. The longer rear portions form counterweight boxes which are loaded with pig iron, so that in emergency they can be unloaded easily and no heavy equipment would be required to dismantle them. In the view of the counterweight beam, Fig. 3, showing the hanger attached to the cross-girder, the low height of the supporting tower is apparent.

To raise and lower the outboard end of the apron according to changes in water level, a chain attached to the rear end of the balance beam is passed down over pulleys from which it leads to the operating hoist (see Fig. 1). At present the hoists are operated by hand, but provision is made for installing electric or compressed-air mechanism. The operating machinery is located on the abutment, directly in line with the counterweight, thus reducing the number of pulleys required.

Foundations—An abutment for the I-beam span, a pier for the six hinge bearings of the apron and two side piers to carry the counterweight towers are all of concrete, supported on pile foundations. The abutment was constructed with precast slabs on timber grillage for that portion directly under the girders, these slabs being introduced to expedite erection. The remainder of the abutment supporting the machinery was poured in place.

Lubrication—All moving parts were provided with

FIG. 3—COUNTERWEIGHT BEAM AND BOX
Rear end of beam widened to form box for pig-iron loading. Hanger is attached to cross-girder of apron.

bronze bushings and fittings for grease-gun lubrication in order to reduce friction to a minimum. In the old apron the pins and pinholes were worn out, and this was one of the principal reasons that made it necessary to renew the structure.

Deck—Track construction consists of 110-lb. rails, with tie-plates, on 8x8-in. ties spaced 12 in. c. to c. At the boat or outboard end, Fig. 4, the rails are protected by steel guard castings on the cast-steel nose pieces of the girders. Just back of these rail castings is placed a pair of standard guard rails. Only the outside rail of each outside track was provided with a guard rail for the full length of apron. In the space between this outside track rail and a guard timber on the ties a bent iron plate running the length of the apron has been introduced to prevent the brine drip from the refrigerator cars from attacking the steel. If this is found effective, it will be placed on the outside of all rails. A sliding joint in the track rails at the shore end of the apron is shown in Fig. 2.

Erection—It was necessary that the change be made in as short a time as possible, because all the traffic had to be handled on the remaining slip. Fortunately, at that time the traffic was sufficiently light that the one slip could handle the boats with little delay. The foundations for the counterweight towers and the hinge pier were completed in advance of dismantling operations. After the slip was put out of commission the old steel was removed by a derrick car and the grillage for the precast slabs was completed. The slabs were set on the grillage and the approach steel and main girders were then placed. The total time required for the change

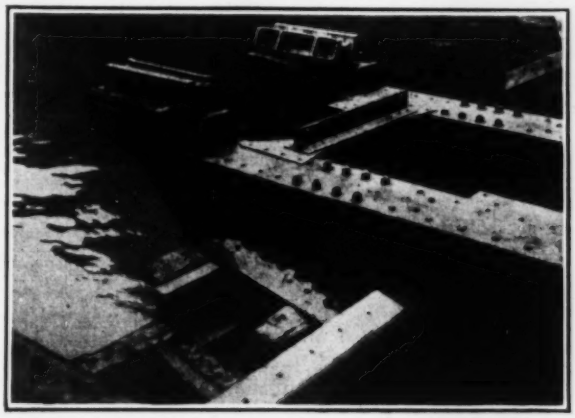


FIG. 4—OUTBOARD END OF APRON GIRDERS
Castings on girders hold ends of track rails.

was two weeks, including two days of bad weather when no work was done. Some pile driving was done at night to speed up the work.

Engineers and Contractors—This apron design was prepared by the writer under the direction of R. H. Howard, chief engineer, and C. S. Johnson, bridge engineer, of the Wabash Railway. The steel was detailed and fabricated by the Wisconsin Bridge & Iron Company, North Milwaukee, Wis., and was erected by the Kansas City Bridge Company. The Inter-Lake Construction Company, Detroit, prepared the foundations.

Unusual Arrangement of Chlorinating Apparatus

Chlorinating apparatus at the Albany, N. Y., water purification plant is housed in four separate rooms with chlorine gas tanks in each of the four rooms. The tanks, however, do not supply the apparatus located in the same room, but are each connected with apparatus in one of the other rooms. This arrangement is carried out as a matter of safety and permits the chlorine gas supply to be shut off without entering the room where leakage is taking place.

Compound Used to Seal Water Meters

All new meters being installed in Jersey City, N. J., have their register boxes sealed in a simple but effective way. Before the meters leave the shops and after they have been tested, a small amount of red sealing compound is applied on each of the register box screws. While the compound is still warm, an impression is made in the compound with the initials of the Water Department. The meter, however, is not sealed in place in the water service.

Deep-Pit Sludge Digestion at Indianapolis Sewage-Works

Sludge From Clarification and Activated-Sludge Tanks Pumped to Pits With Permeable Bottoms for Reduction

By C. K. Calvert
Engineer in Charge of Sewage Treatment, Indianapolis, Ind.

THE sludge produced at the clarification and activated sludge units of the Indianapolis sewage-works is pumped at 7.72 and 1.12 per cent solids respectively to digestion pits. The pits are about 300 ft. square and leveed to give a depth of from 7 to 10 ft. The depth is being increased by raising levees with sludge and earth and by removing earth to provide level bottoms as the pits are cleaned.

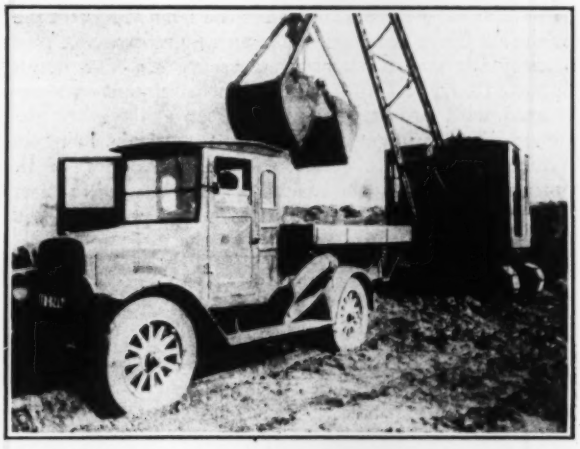
Skimming boxes are provided for the removal of liquor at any depth, it being expected that scum and sludge would be separated by more or less clear liquor. The nature of the soil beneath the pits, however, permits water to run away to such an extent that only occasionally has there been any considerable amount of free water to be removed, and the consistency under the scum is quite uniform from top to bottom.

No chemical or temperature control is provided during digestion, and seeding is effected only incidentally. The two sludges are delivered to the pits through the same pipe, but no special effort is made to have them pumped at the same time.

A pit receives the sludge until it is full. Then the flow is diverted to another pit until it is filled or until the first pit is lowered by filtration into the ground. This intermittent filling effects some seeding. During the filling period the reaction of the pit liquor becomes more acid, particularly in cold weather. One new pit, into which sludge was started on Jan. 1, 1927, maintained a pH of a little under 7.0 and did not recover fully until the middle of the summer. The primary sludge enters the pits at a pH of about 6.8 and the activated sludge at 7.3. Under normal filling conditions the mixed sludge seldom drops during digestion below 6.8 and on standing without the addition of fresh sludge goes to 7.8 and 8.0 in a short time. Hard and fast reaction and time figures cannot be given, since the relative amounts of fresh and digested sludge and the temperature govern the rate of reaction change. The figures cited are given to indicate in general the conditions under which digestion takes place.

The tabulations show the figures obtained in taking stock of the sludge in the various pits. They indicate what may be expected in the extent of digestion using mixtures of the two sludges. The large reduction in volume is due to the nature of the soil on which the pits happen to be built. The extent of digestion of solids is due in part to the long time involved, though the method of filling produces a mixture of some very old and some very fresh solids in each pit. Thus all of them are actively digesting most of the time. Although a relatively large area is required for such a scheme, the cost of construction as well as of operation is low.

The mixture of digested primary and activated sludge has never drained in the pits to less than 80 per cent moisture and for the most part has remained at about 85 per cent. A few trials have been made on small sand beds using as heavy sludge as can be pumped. It seems impracticable to pump sludge containing more than 13 or 14 per cent of solids. On sand beds such sludge drains very little, but surface drying and cracking occur and in fifteen to twenty days of good weather the moisture content has fallen to 60 per cent or less, in which condition it is readily handled. A 6-in. layer of applied sludge appears to be more economical in point of over-all sand bed capacity than a 10-in. layer. In drying to 60 per cent moisture a 50 to 60 per cent shrinkage occurs.



LOADING SLUDGE AT INDIANAPOLIS SEWAGE-WORKS
Clamshell bucket lifts sludge from digestion pit onto truck for removal.

Recently the operation of the digestion pits has been modified, making them in effect deep digestion-settling basins. Sludge is pumped to one pit continuously, and by hooding the outlet on the opposite side of the pit from the inlet, a fairly clear effluent is passed to a second and then to a third pit. The effluent from the last pit has a turbidity of less than 200 p.p.m., though the nitrogen content is quite high. Such a scheme requires provision for the reversal of the flow through the pits or for change in the combination of flow, since the first pit entered soon becomes quite sour and digestion is retarded.

It is believed that, as the proportion of activated sludge increases, draining in the pits will be less satisfactory and that drying beds will be required to put the sludge in condition to be handled.

SLUDGE DIGESTION PIT DATA, INDIANAPOLIS SEWAGE-WORKS

Pit Number	Days Since First Sludge Was Pumped to Pit	Area of Pit, Thou. Ft.	Depth of Sludge, Ft.	Specific Gravity	Per Cent Solids
1 and 2	463	66.0	7.75	1.011	9.66
3	351	86.8	—Sludge being removed—		
4	533	109.5	8.60	1.032	12.00
6	484	89.0	7.37	1.045	12.33
7	273	106.2	8.45	1.023	4.44

Volume of Sludge
Thousand Gallons

Pit Number	Primary	Activated	Total	Residual	Lost	Gal. per Sq. Yd. per Day	Per Cent
1 and 2	10,036	31,720	41,756	3,860	37,896	11.2	91
3	30,540	22,380	52,920	*5,300	47,610	14.1	90
4	12,163	58,888	71,051	7,040	64,011	9.6	90
6	10,804	43,788	54,592	4,910	49,682	10.4	91
7	8,737	20,603	29,340	6,720	22,620	7.0	77

* This quantity was reduced by standing three months to 16,100 cu.yd.

Weight of Sludge Solids
Thousand Pounds

Pit Number	Primary	Activated	Total	Residual	Lost	Per Cent Lost
1 and 2	5,011	3,081	8,092	5,115	4,977	62
3	12,898	5,121	18,019	5,954	12,065	67
4	6,601	5,925	12,526	7,280	5,246	42
6	5,726	5,234	10,960	5,280	5,680	52
7	4,682	4,177	8,859	2,485	6,374	72

In January, 1927, a few growers were induced to try digested sludge directly from one of the pits. It was loaded by clamshell buckets free of charge. By July 31 about 1,000 cu.yd. had been taken and in the next three months more than 5,000 cu.yd. was taken, the experience through the growing season having demonstrated its value as a fertilizer. Several carloads were shipped to a golf course under construction. More than 700 cu.yd. was used on lawns and gardens in the city, making a total of nearly 7,000 cu.yd., or about 40 per cent of the contents of the pit, which went on the soil for fertilizer in the first nine months it was made available for use. In the pit the sludge contains more than 5.5 per cent ammonia calculated to the dry basis. Handling and drying reduce the ammonia content. The sludge contains between 52 and 55 per cent ash. It is thought that the humus in the sludge is as valuable as the nitrogen, since growers seem to get better results than they would from a like quantity of nitrogen in other forms.

The present use of sludge by growers does not solve the disposal problem by any means, but it indicates that it is valuable on the soil and that its use may be developed and extended as growers become more familiar with its advantages.

Problems in Fabricating Silicon Steel for Delaware Bridge

By H. T. Morris
Metallurgical Engineer, Bethlehem Steel Company

(From a paper presented to the New York Section, American Society for Steel Treating)

About 70 per cent, or 7,000 tons, of the rolled structural material in the towers of the Delaware River Bridge was silicon steel. This tonnage consisted of riveted members composed of plates and angles. Most of the angles were 8x8x$\frac{3}{4}$ in. by varying lengths up to 100 ft. while most of the plates were $\frac{3}{4}$ in thick.

The heaviest sheared plates in the towers were ordered to finish $\frac{3}{4}$x134x339 in., weighing 10,300 lb. average. These plates were rolled direct from bottom-poured soaking-pit-heated ingots 22x68 in., weighing 17,400 lb., made in basic-lined open-hearth furnaces. One plate was rolled from each ingot. Rolling was stopped on some ingots to allow chipping of defects, after which the block was reheated and rerolled to finished gage. Because of rejections, the actual yield obtained from ingot to finished plate was about one-third less than would have been obtained from the same-sized plates in standard structural steel.

The major plate tonnage was rolled from slabs bloomed from top-poured basic open-hearth soaking-pit-heated ingots 28$\frac{1}{2}$x40 in., weighing 20,000 lb. average. The slabs were reheated in gas-fired horizontally charged furnaces for finished rolling in 110-in. or 60-in. mills. Slabs were allowed to cool off, then examined and carefully chipped before reheating for finished rolling. The yield of all plates from ingots was one-fifth less than normal for standard structural grades on the same mills.

All angles were rolled from blooms reheated in a gas-fired continuous furnace feeding the structural mill. These blooms were rolled from basic top-cast ingots. Inspection of the finished angle bars, which were rolled in lengths of 100 ft. or more, resulted in substantial rejections because of defects, these being principally in the flanges.

The chemical specifications for basic silicon steel determined from drillings from a test ingot taken during the pouring of each melt, was as follows:

Carbon	Manganese	Silicon	Phosphorus	Sulphur
Not over 0.40	Not over 1.00	0.20 to 0.40	Not over 0.04	Not over 0.05

The manufacture of the steel was conducted in three different open-hearth plants whose melts varied from 75 to 95 tons. In the plant which made the 75-ton melts, additions of ferrosilicon were required more than seven times as heavy as those for usual structural steel. Such additions, if made in the furnace, attack and seriously damage the basic linings, so that only a part, about 20 per cent, of the silicon used was added. This was put in 40 minutes before tapping as 14 per cent ferrosilicon; the remaining 80 per cent of the silicon was added in the ladle as 50 per cent ferrosilicon. The manganese was also added in the furnace, 6 minutes before tapping, as 80 per cent ferro. In order to protect the furnace linings from the silicon added in the furnace, 2$\frac{1}{2}$ times its weight of burned lime was added with it.

Specifications like this for silicon steel increase the percentage of "heats missed" in the open hearth, in spite of expert attention. This is because the allowable practical range of hardening elements, that is, carbon, manganese and silicon, is reduced by the narrow zone established in the finished physical test requirements between steel that is hard enough to have the required strength and steel that is soft enough to have the required ductility.

Economic Problems

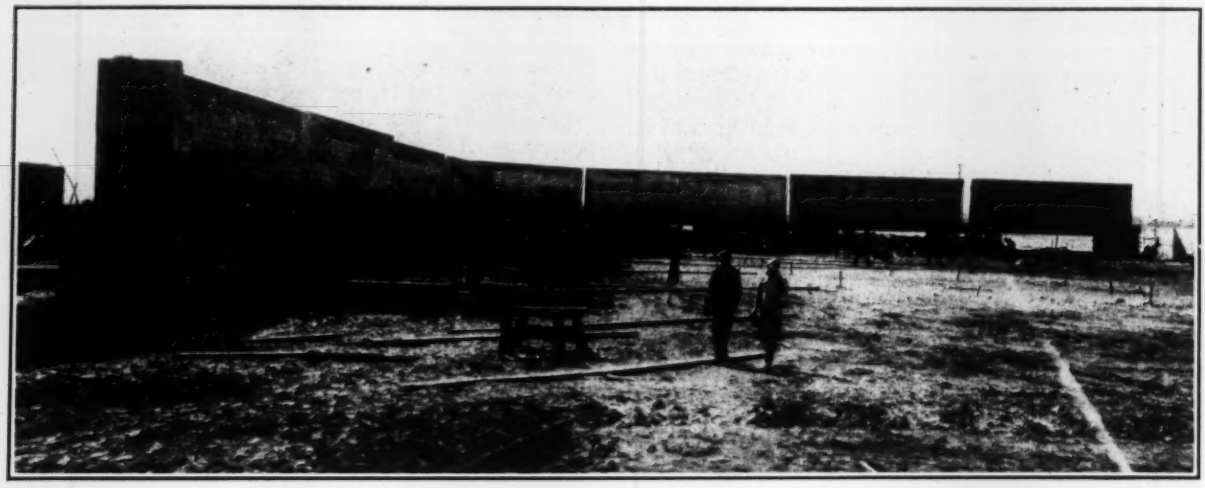
Something of the economic problems connected with strong structural steels should be mentioned. Mass production has helped to keep down the cost of standard steel. When a special grade such as high-carbon, high-silicon steel is introduced into a plant operating on standard steels only, production is at once retarded. The alloys cost more, making the ingots costlier; the ingots require greater discards, increasing the cost of the material in blooms and slabs; the heating time is increased, because the furnaces must be charged at lower temperature; the finishing-mill rolling time is increased, because the physical properties can be certainly attained only by controlling temperature during rolling. Also, problems involving difficulty and added cost arise in the necessity of keeping separate the special grade in mills, storage-yard, inspection and shipping stations. More heats are missed and, because missed heats are of grades seldom used, more ingots must go into scrap. The higher price of special steel causes the purchaser or his inspector to demand more perfection in the specialty, and thus the smaller percentage of ingots which reaches the rolling mill is subjected still further to increased rejections in the finished inspection. The rejected material usually must be cut to scrap.

In the fabrication of the stronger steels, the speed of drilling, reaming, planing, etc., is seriously retarded and tool cost is materially increased. Limitations are also set upon the diameter of holes and upon the thickness of material that can be punched. Therefore, unless the purchaser of silicon steel can correspondingly diminish the weight needed for his structure, he will not gain money advantage. When but a small quantity of special structural steel is desired, this cost disadvantage is at a maximum.

Reinforced-Concrete Wall Moved 1,000 Ft.

Forty Sections of Concrete Fire Wall Surrounding Oil Tanks Moved on Rails to New Location—Steel Oil Tanks Moved to New Site by Floating

IN THE construction of a 1,000,000-hp. steam-electric generating station now being built by the Southern California Edison Company at Long Beach, Calif., it was necessary to move two 30,000-bbl. steel tanks, used for fuel oil, which occupied part of the new plant site. Both tanks and the concrete fire wall surrounding them could be used in a new location about 1,000 ft. distant and it was decided to move both wall and tanks to the new location. The wall was cut into sections and moved on rails; the tanks were moved bodily by floating them in a series of temporary ponds formed by earth dikes retaining sea water pumped in for the purpose. The cost of moving to the new location in this way is said to have been far less than the cost of dismantling and reassembling the tanks plus destroying the old wall and building a new one at the new location.



SECTIONS OF THE WALL IN NEW LOCATION
Sections resting in approximate location waiting to be lowered to final position.

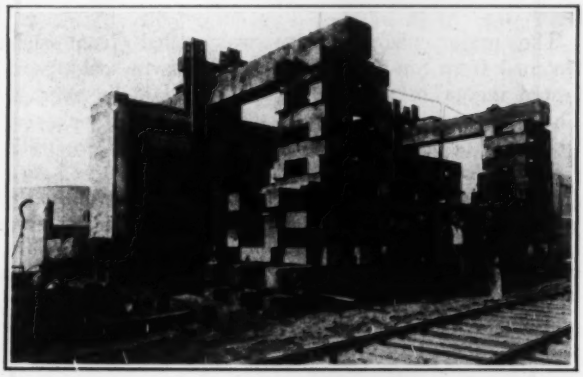
The total length of the wall to be moved was 1,300 ft. It is of the vertical cantilever type with light steel reinforcement, having a height of 11½ ft. and a uniform thickness of 12 in. The base is 18 in. thick and extends 2 ft. on either side of the center line. The sections into which the wall was cut were 35 ft. long and weighed approximately 70 tons each.

The first step in the removal was to make a cut separating the portion of the wall to be moved from the remainder. A trench was then dug on either side of this section, extending down to the bottom of the concrete. With the aid of hydraulic jacks the section was then lifted from its bed, the lift being about 5½ ft., or enough to permit of advancing the section on rollers over a standard-gage steel flat car on a track laid in a trench just ahead of the section. The hydraulic jacks, four of which were used in raising and lowering each wall section, were designed and built on the job.

In raising the wall sections the weight was carried by two 24x24-in. Douglas fir needle beams, placed transverse to the wall section and supported on timber cribs. These beams were protected against bending and crushing by three 8-in. I-beams, 10 ft. long, placed near the middle, where the weight of the wall section was concentrated. Connection with the wall section was made with the aid of 20-in. steel channel irons, slung from the two beams and attached to the wall by heavy bolts for which holes had been drilled through the concrete about 3 ft. above the base of the wall.

The four hydraulic jacks were operated simultaneously by parallel connection with an air-driven hydraulic pump. The jacks were placed under each end of the needle beams just inside the timber cribbing. As each end of a beam rose it was followed with blocking, 12-in. timber blocks being lifted to place with the aid of davits set on either end of the needle beams.

When a wall section had been delivered to its new location, the lifting process was reversed—that is, timber cribs and needle beams were set up, the weight was taken by jacks and lowered gradually to the final position. Just before each wall section came to rest, a thin bed of grout was poured between the bottom of the wall and the waiting foundation. Each section was accurately leveled up as it was bedded, and as each adjoining section was placed

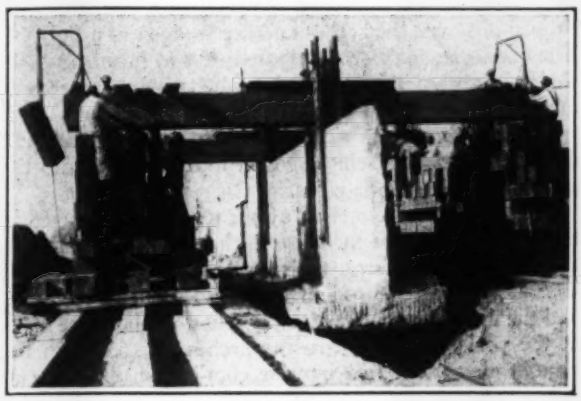


LIFTING ONE OF THE 70-TON WALL SECTIONS
Note method of making fast to the wall. In right center is the air-driven hydraulic pump serving four jacks.

a tight, permanent connection was made by pouring concrete grout to inclose the joint.

In moving the tanks it was necessary to brace the floor plates against an upward thrust of 57.6 lb. per sq.ft., the limiting factor being permissible stresses on the riveted joints in the tank. It was also necessary to support the roof columns so as to prevent these columns from punching through the floor. Both the upward thrust on the bottom of the tank due to the hydraulic lift and also the weight of the roof, through the roof columns, had to be transferred to the side walls.

The unusual stresses imposed on each floating tank were taken up by a timber truss built inside, designed to transmit the thrust to the sides of the tank. The



END VIEW OF WALL BEING RAISED
Note position of hydraulic jacks and davits for raising timber blocking.

truss consisted chiefly of 12x12-in. and 12x14-in. timbers placed radially on the tank bottom, with inclined braces carrying the thrust to the walls. Thirty-six radial timbers were used. Columns and roof loads were transmitted to the radial timbers through two concentric rings of 12x12-in. beams, the columns transmitting their load to the beams by means of timber clamps. The inclined braces from the outer concentric ring of timbers were fitted under clip angles in the third circumferential band of rivets, and from the inner ring the braces extended to the clip angles supporting the rafters at the top of the tank wall, these long braces being sidebraced to prevent buckling. Upright timbers and clip angles transmitted the vertical thrust at the outer ends of the radial beams directly to the tank walls. Before the timber trusses were built the tanks were thoroughly cleaned with steam to reduce the danger of slipping.

After the tanks had been properly braced, the dikes were constructed by means of scrapers and clamshell buckets and water was pumped into the inclosure so formed until the depth was sufficient to lift the tanks from their foundation. The draft of each tank with its bracing was about 11 in., but because of the uneven nature of the ground surface it was found advisable to make the pond depth about 20 in. The tanks floated on on even bottom. Guide ropes were fastened to the sides and rear to control the direction of travel and balance the wind pressure. The second tank to be moved traveled the 825 ft. from old location to the new site in 6¾ hours. The tanks are 86 ft. in diameter, 30 ft. high and, with the timber bracing, weighed about 168 tons.

Tanks and wall were moved for the Southern California Edison Company by Stone & Webster, Inc., under the direction of S. L. Shuffleton, Western manager.

How Construction Contracts Were Drawn 200 Years Ago

By Harry K. Ellis
County Engineer, Chester County, Phoenixville, Pa.

WHEN William Penn landed in Pennsylvania in 1682 he immediately established three counties. As Chester County is one of these, one may expect to find among the original records of this county papers of interest to the engineers of our own time. One such document copied from the records in the office of the Clerk of Courts should be of particular interest to the contractor who always wants the full amount of his monthly estimate promptly on the first of the month. It is given below, the spelling, capitalization and punctuation being as in the original.

Articles of Agreement Indented made & fully concluded upon, on the first day of October in the Year of our Lord One Thousand Seven Hundred and Thirty Nine Between Sam[l] Lightfoot John Parry and Joshua Thomson Gen[l] Commissioners of the County of Chester of the one Part and Nathan Worley and John Dutton of the County of Chester also in the Province of Pennsylvania Carpenters of the other Part

Witnesseth that the S[d] John Dutton and Nathan Worley have agreed with the above named Commissioners to Rebuild or Repair Ridley Bridge and Chichester (or Marcus Hook) Bridge after the following Manner Viz. To Drive seven good sufficient Piles in one Teer at the East end of Ridley Bridge near the Creek side and also to drive five good piles in the said East End in the Causway which said piles and caps all are to be of the heart of pine and cap'd or Cover'd with the like Timber sufficient to support the sleepers of the said Bridge and to lay seven Good sound sleepers of White Oak on each Teer after the following Manner the S[d] Sleepers are to be fifteen inches deep and five inches thick and to be sheathed with two inch Oak Plank on the Upper Edge and to Extend in Length from the Same Piller or abutment on the West Side of the Bridge afores'd to the Eastermost Teer of the Piles in Order to Lay Plank thereon and to Plank the Said Bridge from end to end of the Said Sleepers with Good Sound White Oak Plank three inches thick and of the usual length and to erect sufficient hand rails each side of the Bridge Afores'd after the best (or Workmanlike) Manner and to Spike a two inch Plank a foot Wide along the Side of the Said Bridge from End to End on the Cross Planks with one Spike in Each and to drive a sufficient row of Piles along each side of the Causway joining to the East end with good land ties to hold the Said Causway together and to fill the same to join the Said Bridge with Earth, Stone, or Gravel after the best and Workmanlike Manner.

And it is agreed that the Marcus Hook Bridge be Repaired after the following Manner Viz To drive five Piles in a Teer at the East End of the Said Bridge and Cap or Cover them as Afores'd (the Piles to be of the heart of Pines as for Ridley Bridge) to lay five good sleepers one foot three inches deep and five inches thick of Good White Oak and sheath'd on the upper Edge as above mentioned and Extend from the stone Pillar or Abutment to the Pillar at the East End and to plank the Said Bridge with Good White Oak Plank three inches thick from end to end of the Said Sleepers and to lay a two inch plank a foot Wide along each side of the Bridge and Spike it as above and Erect and put up hand rail after the best Manner and also build a Causway or Wharf of Logs and fill the same with Earth or Gravel to join the East of the Said Bridge after the best Manner or form, Now these present Witnesseth that is fully Concluded and Agreed on by the Above persons Concerned that the Said Nathan Worley and John Dutton for themselves their Heirs Executors and Administrators doth Covenant and Promise to and with the Said Commissioners and their Successors, the Com'rs of the County of Chester for the time being, that the afores'd

Nathan Worley and John Dutton their Heirs Executors, Adm'rs or some other person for them shall well and truly perform, fulfill and accomplish the above Articles of Agreement with respect to Building the Said Bridges and repairing the Causways of both the Said Bridges and finding Materials for finishing the same on or before the First day of June Next and also that the Aforesaid John Dutton and Nathan Worley Maintain Support and Uphold against all Natural Decay or any Defect of Workmanship the Said Bridges Supporting Piles or other parts of ye Timber Work for the Term of Ten Years after they are Finished at their own proper Cost and Charges and in Consideration thereof they the Said Com'rs in behalf of themselves and their successors as Afores'd have Agreed to Allow the Said Nathan Worley and John Dutton an Order on the Treasurer for the Sum of One hundred and twenty Pounds to be Paid by the County Treasurer when the Circumstances of the County will admit of the same For consideration thereof the Parties hath to these presents set their hands and seals the Day and Year above Written.

Stress Analysis of 90-Year-Old Wooden Bridge

Exactness of Design and Craftsmanship on 240-Ft. Span Fits It to Carry Traffic Far Heavier Than Original Design Contemplated

By Nelson J. Bell and J. K. Grannis
Engineers With Schenck & Williams, Architects, Dayton, Ohio

AT CAMP NELSON, Ky., about 20 miles from Lexington, there is a 90-year-old wooden bridge, unusual in design and construction and in its preservation. The authors made a study and stress analysis of this structure which disclosed a number of remarkable features, especially the mathematical exactness of the design and its perfect adaptation to the materials and labor available in the locality at the time it was constructed. The bridge was designed and built in 1838 by Louis Wernwag, the well-known bridgebuilder. The authors' study resulted from the efforts of interested citizens to have the bridge preserved following unsuccessful repair of its floor system and subsequent condemnation by the state highway department. The analysis showed that, with restoration of the bottom lateral system and with some slight local reinforcement, the bridge is amply able to continue indefinitely to carry traffic far beyond the intention of its original designer.

Description of Bridge — The bridge carries the Lexington-Danville pike across the Kentucky River on a single span of 240 ft. between abutments, and has three trusses supporting two roadways, each about 12 ft. wide. The center truss is straight, but the two outer trusses are curved inwardly, forming flat arches equal and opposite to each other, so that the bridge is wider at the ends than in the center. The trusses otherwise are identical in every respect. All members are constructed of hewn timbers, except that bolts are used to prevent the parts of a member from spreading apart, that suspender bolts support the floorbeams, and that tension rods are used in the bottom lateral system and for anchoring the bridge ends to the abutments. The craftsmanship is as nearly perfect as can be imagined, the framing and joining being as accurate as if it were cabinetwork. The total freedom from racking or local distortion after 90 years of use bears witness to the excellence of both the design and the execution of the work.

The truss is essentially an arch braced laterally and vertically by a stiffener truss, as may be seen in the accompanying drawing, where an elevation and a cross-section of the bridge are given. The arch is an arc of a circle with all posts of the stiffener truss placed normal to the arch curve and spaced equally along the arch, except the first two at each end. Each type of the stiffener truss members has the same section throughout. The chords are parallel, and each is composed of four members. The joints in the chord are made by means of tabled packing blocks. The posts are composed of three members each and are carried through and beyond each chord, chords and posts being dapped and exactly fitted together at their intersections to form rigid joints effective in both tension and compression. The posts are dapped out over the arches and are wedged to a tight fit. The main diagonals are composed of two members each, wedged tightly into daps cut into the two outer members of the posts, and pass outside of the arch members. The counter-diagonals are single members and pass between the arch members, being wedged into daps cut into the center members of the posts.

The arches are composed of six members, arranged in two groups of three members each. Since there are no cuts in these members, their full sections are effective. The arches are clamped firmly in position by the posts and the diagonals of the stiffener truss. Splices are made at the posts only. Where the arches pass through the bottom chord, the two interior chord members are cut, but the two outer members are carried past the arches without break. The ends of the arches are held by double oak wedges driven between end plates which bear on the arch members, and skewbacks placed in the stone abutments. The ends of the stiffener trusses rest on sills placed on the abutments, and are anchored to the abutments by wrought-iron rods extending from the top chords down into the masonry.

TABULATION OF STRESSES ON OLD WOODEN BRIDGE

Member	Upper Chord	Lower Chord	Main Diags.	Counter Diags.	Posts	Arch
Net sec., sq.in.	120	144	64	275	76	432
Max. tens., lb.	46,200	19,500	0	0	31,000	0
Max. comp., lb.	15,600	43,600	13,700	17,000	0	467,700
Unit tens. (with grain), lb./in.^{2}	386	136	0	0	408	0
Unit comp. (with grain), lb./in.^{2}	130	304	214	618	0	1,080
Area end joint, sq.in.	60	72	23.5	10.6	(a)	432
Max. stress on joint, lb.	9,000	10,000	13,700	17,000	31,000	467,700
Unit stress end joint (with grain), lb./in.^{2}	150	139	583	1,600	(b)	1,080
Area of shear (with grain), sq.in.	.....	.....	.....	.....	432	.....
Unit shear (with grain), lb./in.^{2}	.....	.....	.....	.....	72	.....
Area bearing on arch, sq.in.	.....	.....	.....	.....	72	.....
Unit bearing on arch (across grain), lb./in.^{2}	.....	.....	.....	.....	430	.....
Bearing area posts on chords, sq.in.	.....	.....	.....	.....	54	.....
Unit bearing posts on chords (across grain), lb./in^2	.....	.....	.....	.....	575	.....

(a) Bearing of chords on posts, same as end bearing of chords except it is across the grain. Unit stress, 150 lb./in.^{2} on upper chord and 139 lb./in.^{2} on lower chord.
(b) 31,000 lb. load on posts equals uniform live load plus two-thirds dead load plus 24,000 lb. from two trucks passing. It is unlikely that uniform live load and truck loads could occur simultaneously.

The top lateral system is made entirely of wood. At each panel point a cross-strut extends the entire width of the bridge and is dapped over and bolted to each upper chord. Between the struts there is a double system of X-bracing fitted and wedged into daps in the struts so as to be effective in both tension and compression.

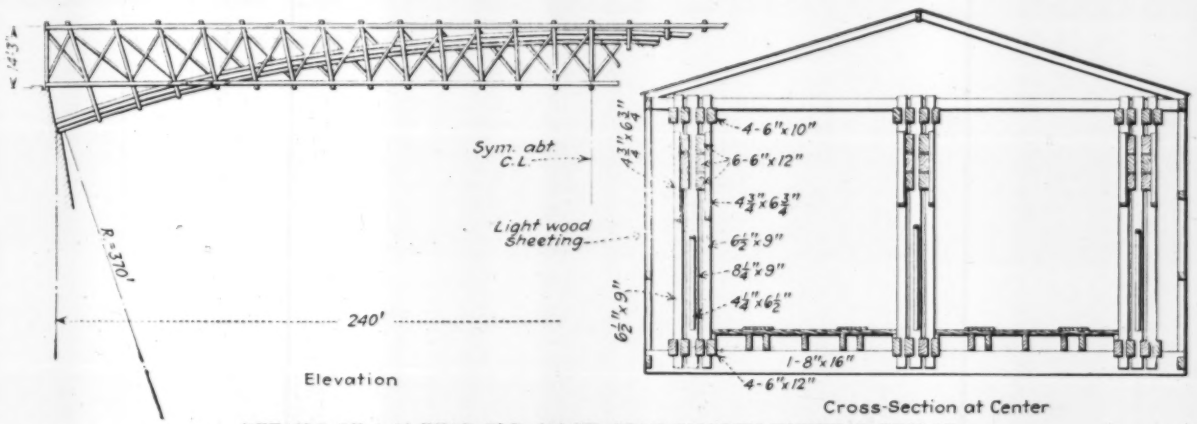
The original bottom lateral system, which was practically all replaced during the reconstruction, was made

of wooden floorbeams and lateral wrought-iron tierods, three truss panels forming one lateral panel. The 8x16-in. floorbeams were dapped out 4 in. where they crossed under the bottom chords of the trusses. They were continuous under both roadways and extended 2 ft. beyond the outer trusses, thus forming struts and ties holding the trusses in alignment. The 1-in. square wrought-iron rods passed diagonally through these struts near the outer trusses and through holes in the intermediate floorbeams, crossing under the center truss. All floorbeams were suspended from the lower chords by wrought-iron bolts. The floor was made of planks placed on stringers, which in turn rested on the floorbeams. Although perhaps too light for present-day auto trucks, this floor system was perfectly capable of carrying all but the heaviest highway loads, and its partial failure and consequent condemnation can be charged only to the recent method of reconstruction and not to the original design or construction of the bridge. With proper replacement of the floor and bottom lateral system and with the reinforcement described hereinafter, the bridge can adequately serve for many years.

In analyzing the stresses in the stiffener truss, an extreme loading was assumed. This consisted of two fifteen-ton trucks passing each other at one end of the bridge so that their rear wheels were opposite each other and the front wheels of one truck were on the first panel point. This position of the trucks caused the greatest eccentricity of loading and therefore the greatest stress in the stiffener truss. The maximum stresses of the various truss members are given in the accompanying table. The compression in the arch due to the concentrated live load was 44,700 lb.

The weakest members of the structure were the counter-diagonals, which have a maximum load of 17,000 lb., a cross-section of $4\frac{1}{4}$x$6\frac{1}{2}$ in. and a length of about 16 ft. It is believed that these can be adequately strengthened by bolting them to the main diagonals through spreader blocks.

The weakest joints are those between the posts and the lower chord. Here the floorbeam reactions and the weights of the lower chord and diagonals are carried on dapped joints. These joints can be made to carry modern wheel loads by the addition of suspender rods carrying part of the floorbeam load directly to the posts.



DETAILS OF A 90-YEAR OLD, 240-FT. SPAN WOODEN HIGHWAY BRIDGE
Unusual craftsmanship shown in the three arches and stiffener trusses supporting the roadway.

Stress Analysis—In investigating the stresses in the members of the trusses, the center truss was selected, since it carried half of each of the two roadways plus its own weight, whereas the other trusses each carried only half of one roadway, the weight of half the light wooden inclosure, its own weight and the wind loads.

The following assumptions were used in constructing stress diagrams for the stress determination:

1. Under dead and uniform live loading the stiffener truss is not stressed as such, the only stresses being local stresses caused by the carrying of floorbeam loads and dead loads to the arch. Thus the posts are all in tension except at the ends, where the arch is below the floorbeams, and the posts therefore are in compression.

2. Under any loading the arch is in compression only, as all applications of load are normal to the arch and are uniformly spaced. The center of compression therefore is along the center of the arch section.

3. Eccentric loading is distributed uniformly to the arch by the stiffener truss.

The dead load on the truss averaged 710 lb. per lin.ft. of truss, while the uniform live load was taken at 450 lb. per lin.ft. These loadings gave a compression in the arch of 259,000 lb. due to dead load and 164,000 lb. due to uniform live load.

In the analysis no allowance was made for impact, for the reason that the dead weight of the bridge is about 260 tons and the impact effect of a fifteen-ton truck would be practically negligible. The bridge was measured and the stresses computed by the writers for the Bower Bridge Company, Maysville, Ky.

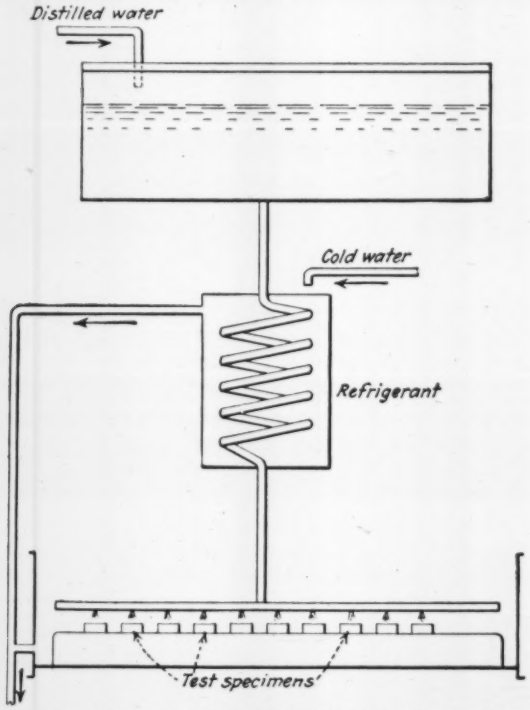
Picnic Grounds Adjoin Water-Works Reservoir

An unusual departure from the custom of prohibiting people on reservoir sites has been made by the city of New Brunswick, N. J., in establishing picnic grounds in a grove immediately adjoining the new 1,000 m.g. water supply reservoir, completed in March, 1927. The city has built tables and benches for public use and has granted a concession for serving refreshments on the grounds. No attempt is made to prevent boating or bathing in the reservoir, which spills over a concrete dam and flows along the creek bed until it is collected in a second reservoir. From this point the water is pumped to a purification plant where it is filtered and chlorinated before going to the city. The grove was acquired by the city as a part of the property purchased for the reservoir site.

Action of Pure Water on Cement Mortar Briquets

French Tests Show Disintegrating Effect of Distilled Water—No Change Results From Using River Water

LONG-TIME tests made by French engineers to determine the action of various waters on briquets made of cement mortar, reports *Le Génie Civil* in a recent issue, show that distilled water has a decidedly disintegrating effect on such mortar specimens, whereas ordinary river water with a calcareous content has no effect whatever. The tests were made in the laboratory of the Société des Chaux et Ciments de Lafarge et due Teil upon specimens made from six types of cement in ordinary commercial use. The results, the laboratory reports, were practically identical on all mortars, whether made of portland cement or analogous cements. The cements used included natural, slag, limestone, quick-setting and high-alumina. The tests covered a period of approximately 100 weeks. The only briquets to resist the disintegrating action of distilled water were those made of high-alumina cement, known as *ciment fondu*.



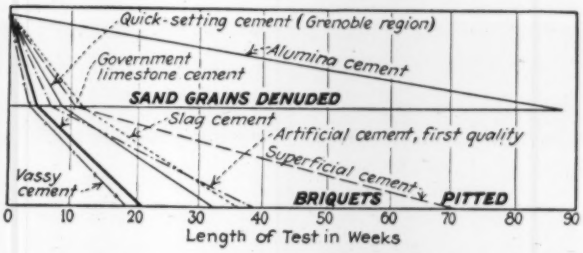
APPARATUS FOR DISTRIBUTING WATER TO TEST SPECIMENS

At the end of 100 weeks, when all of the other briquets had become badly pitted by the continuous action of the water, *ciment fondu* was scarcely affected.

Briquets tested were cut in half so that each half of the same mixture could be tested under identical conditions as to mix and curing conditions with distilled water and river water. Briquets were cured for 28 days under normal conditions in potable water. Some tests were also made with mortars cured a week under water and for three weeks in humid air, but results of these tests were only slightly different from the others.

The distilled water was collected in a reservoir in which the water level was kept at constant height. From the condensers of a power station the condensate was led through a coil placed in a chamber filled with river water in such manner as to attain the temperature of the river water, and then was discharged upon the briquets through holes in an inverted T, whose horizontal branch was 2 in. above the briquets (see sketch). A similar arrangement was used in the tests with river water. The flow of water through each hole in each case was approximately 1 liter per minute.

Effects of the dissolving action of the water were noted



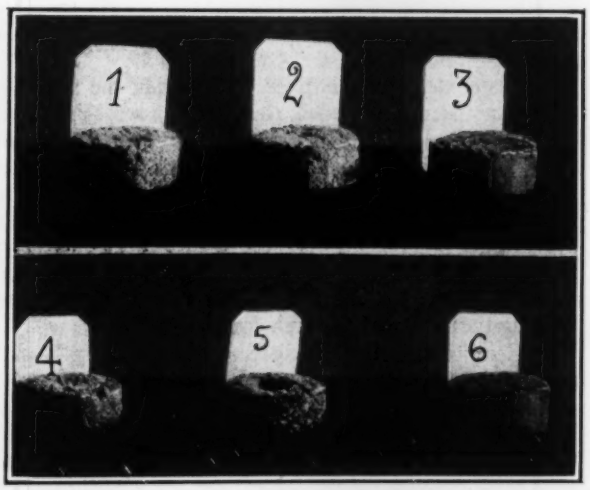
GRAPHICAL COMPARISON OF RESULTS OF TESTS ON VARIOUS CEMENTS UNDER THE ACTION OF DISTILLED WATER

in two successive stages. The first stage was considered reached when the sand began to be bared of its cement, and the second on the formation of distinct pits in the face of the test specimen. These pits in some cases became deep holes. The duration of the first attack on the briquets (when the grains of sand began to be denuded) varied from five to twelve weeks. The longest time specimens resisted the denuding action was little more than twelve weeks, except in the case of high-alumina cement, which resisted that action up to around 100 weeks. The time at which the second or pitting stage was reached ranged from about eighteen weeks up to 71.

Etienne Rengade, director of the laboratory and under whose supervision the tests were made, has the following to say regarding the conclusions which the tests indicate:

We all know that carbonic acid exists in water in two states: (1) in a free state and (2) in the form of bicarbonate of lime. For water containing only 30 mg. of lime per liter, a common figure, this bicarbonate of lime represents 50 mg. of carbonic acid, of which half can be combined with a new quantity of lime.

On the other hand, we know that with the setting and hardening of siliceous and silico-aluminous cements hydrated monocalcium silicate is formed and hydrate of lime liberated. This latter is one of the constituents of hardened concrete. The lime is easily soluble in the pure water, which dissolves a little more



EFFECT OF DISTILLED WATER ON VARIOUS MORTARS

than 1 gr. per liter: on the contrary, on contact with free carbonic acid or bicarbonate it is transformed into neutral lime carbonate, which is insoluble.

From this one can understand the difference of action on cement of very pure waters and waters reasonably calcareous. The first, containing only insignificant proportions of carbonic acid, act as dissolvents on the lime in the mortar, which is little by little broken down. The second, in contact with this same lime, precipitates neutral insoluble lime carbonate, which closes the pores of the mortar and protects it instead of altering it.

Owing to the special constitution of alumina cement entirely different phenomena of setting and hardening without liberating any lime occur. It has been shown that in hydration of alumina cement hydrated monocalcium silicate and dicalcium aluminate are formed and alumina in place of lime is liberated. If, then, it is the dissolution of the free lime which causes the attack on portland cement by pure water, high-alumina cement should resist the attack under the same conditions.

Tabulation of Test Data on Unit Strength of Welded Joints

An extensive series of tests of welded structural joints is about to be started by the structural welding research committee of the American Welding Society. As a preliminary to this test work a subcommittee compiled all prior test results on welded structural joints, including both butt and fillet joints, the latter in both longitudinal and transverse arrangement. That part of the compilation which relates to the unit strength of welded joints is given in the accompanying table. All of the welds were produced by the arc process except as noted.

FILLET WELDS

Reported by	Specimen Sketch	No. tested	Welds Size Lgth.	Size Fillet	Ult. Strength lbs. per lin. in. Min.	Ult. Strength lbs. per lin. in. Aver.
H. E. Grove A. W. S. Journal Jan. 1927		18 12	1" to 6" 1" to 4"	5/16 5/16		1" = 7500 6" = 5100 1" = 7250 4" = 6658
Do.		18 6 4 3 5	.52-1 .51 Av. 1.59 Av 1.55 1.15-1.66	9/64 3/16 1/4 5/16 5/16	3090	3630 4490 5680 5810 7870*
Do.		6 6	2 4	1/2 1/2		11841 10806
Do.	3"Pl.	3 6	3 3	5/16 1/2		10810 15450*
Do.	3"Pls.	3 6 6	3 3 3	3/16 1/4 5/16		9000 10290 15450*
R. A. Storm A.W.S. Journal Jan. 1926	2"Pls.	7 8 9 6	2 2 2 2	1/4 5/16 3/8 1/2	9650 9830 9680 14700	10640 11210 13040 16110
E. S. Humphreys Union Coll. Iron Age May 25, 1922	¼"L ¼"L	1	15" Total each side			7650
Do.		1 1 1	4 3 1	3/8x1/2 do. do.		9550 9890 11390
Do.	A B	4 4 4 4 4	3 3 3 3 3	A: 1/2, 3/8, 3/8, 1/4, 1/4 B: 1/2, 1/2, 3/8, 3/8, 1/4		11880) 10850) 10000)* 8050) 7470)
Am. Br. Co. Ambridge Oct. 25/26	1½ and 2"	1 1	1 1/2 2	3/8 3/8		8020 7350
Do.	1½" 1½"	2	1-1/2	3/8	8060	8100
Am. Br. Co. 1919/1920	1½"x⅜"Pls.	9	1-1/2	3/8	3750	5150
Am. Br. Co. June 10/26	2½"x½"Pls	3	2-1/2	1/8	8690	10820
Do.	2½"x½"Pls.	2	2-1/2	1/2	14250	14510
Do.	2½"x½"Pls.	3	2-1/2	1/2	10570	12080
Emergency Fleet Corp. Report on Elec. Weld. 1918 Report #7.	Pls. 9"wide	3 3 3 3	9 9 9 9	1/4 5/16 3/4 1		6770 8810 17620 25280

* Double Run

BUTT WELDS

Reported by	Specimen Sketch	Specimen Thick Pls.	Specimen No. Tested	Weld Ult. Strength lbs. per lin. in. Min.	Weld Ult. Strength lbs. per lin. in. Aver.
H. E. Grove A. W. S. Journal Jan. 1927	Width not given	3/16 1/4 5/16 3/8	3 2 2 12		12000 14400 17650 18955
E. E. Thum Linde Air Products Co. A.W.S. Journal Nov. 1926 (Gas Welding)		Not Given	About 500	47000# / sq. in. Norway Iron Rod 58000# / sq. in. High Test Rod.	
Hobart A.I.E.E. Feb. 1919	Specimens 1"x⅜" cut from 8"x½" pls. after welding	1/2	33	17100	25420
Do	Size same as above	1/2	11	23900	29410
Am. Bridge Co. 1919-1920	1½"x⅜"Pls	3/8	7	14810	15710
Do	1½"x⅜"Pls	3/8	12	15260	18100
Am. Bridge Co. June 10/26	2½"x½"Pls. 2½"x½"Pls	1/2 1/2	3 3	20850 24280	21860 25030

Simplified Practices Spreading

Continued growth of simplified practice as a means of eliminating waste in industry is evidenced by the completion during 1927 of eighteen new simplified practice recommendations, thus bringing the total projects completed to 80, according to a review of last year's activities of the Commercial Standards Group, Bureau of Standards, by Ray N. Hudson, assistant director in charge.

That simplification yields benefits sufficient to attract manufacturers, distributors and consumers alike is demonstrated in the high degree of adherence shown by recent reviews of fifteen simplified practice recommendations already promulgated. The report shows that acceptors representing an average of 82.61 per cent of the total volume of the industry affected are following the simplified practice schedules. The list of association indorsers grew from 686 to 898 during the year, and the number of individual concerns adopting the recommendations increased from 2,775 to 6,676.

Mr. Hudson cites as instances of savings because of simplified practice one community reporting savings due to asphalt grade simplification of 5 cents per square yard and another 25 cents per square yard on its paving. A manufacturer of concrete building units reports savings of $11,500 per year due to simplification in his field. Many others report better turnover, quicker delivery and improved service to the trade as benefits accruing from simplified practice.

During last year 208 business and industrial leaders visited the Division of Simplified Practice to learn at first hand the work being done to eliminate avoidable waste in industry.

Signals for Highway Intersections

Logical Order of Placing Colors in Signal Box, Uniformity of Location and Height Are Essential Requirements

By Lewis E. Moore
Consulting Engineer, Boston, Mass.

OBSERVATION made of the unnecessary burdens put on the motorist by the indefensible method of locating many traffic signals and the use of varying indications at different places moves the writer to supplement his article in *Engineering News-Record,* Jan. 22, 1925, p. 140, on "Railway Signaling Methods for Public Roads." A reasonable and logical method of signaling traffic intersections is set forth in this article, based on what the railroads have learned by costly experience.

Railroads have found three things desirable: (1) To locate signals as far as possible always in the same position with reference to the track signaled, so that enginemen can distinguish them readily. (2) To put signals

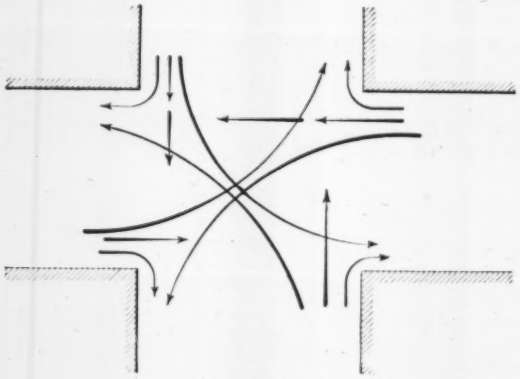


FIG. 1—POSSIBLE MOVEMENTS OF DRIVER AT CROSSING

at the stopping point. (3) To have a uniform system of indications—that is, to have the same signal indication mean the same thing at every point, and to use the same system at all points.

Uniformity of indication is a very desirable thing. As traffic signals are now installed, in some places a single green light is used for all moves. In other places right and left turns have separate indications. In still others a red light allows a right turn. And the motorist who makes a move in Smithtown that is perfectly right in Jonesville finds himself in the clutch of some Smithtown minion of the law, who arrests him because he has not made quite his required number of arrests that week.

In what follows only signals given by colored lights will be considered. An endeavor will be made to develop a logical system that is flexible enough to meet every need, and at the end of the article some of the more common errors made in locating signals will be pointed out, as well as reasons why they do not accomplish as much as their installers had hoped for.

One cardinal principle that should never be violated is that red lights should be so used that they will always mean "stop." Further, they should be located so that the motorist should never pass them.

A Suggested System of Lights—Fig. 1 shows a right-angle intersection with all the possible moves indicated. These moves look complicated, but really analyze out into considerable simplicity when one motorist at a time is considered. The motorist approaches the intersection on one street only and does only one of four things—stops, proceeds straight ahead, turns right or turns left. To give an indication for each of these moves is simple and requires a signal such as is shown in Fig. 2. The indications are as follows:

Red: *Stop.*

Green (or yellow) arrow pointing to right: *Turn to right.*

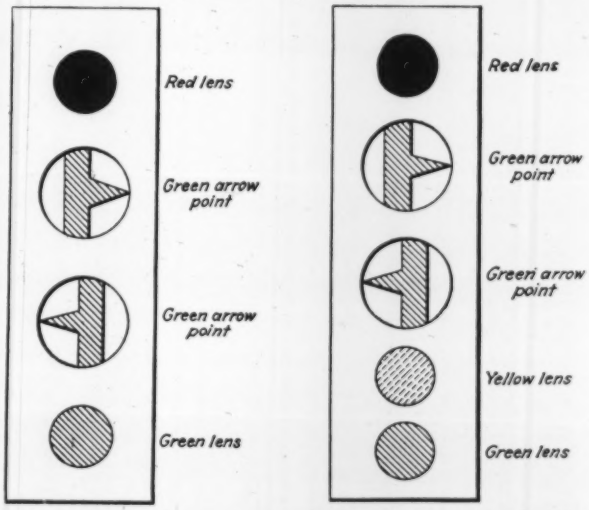
Green (or yellow) arrow pointing to left: *Turn to left.*

Green light: *Proceed straight ahead.*

The reasons for these indications and their location in the exact order shown are as follows: Red is the most important, as it indicates stop, and therefore it should always be in the most commanding position. It should always be at the same end of the signal case or box containing the lenses, so that the color-blind driver will know from the location of the light in the case that it is red. He can easily tell what the signal light means by its location in the case. It would be most unfair to deprive color-blind persons of the right to drive a car. They are not a menace so long as they can read a signal independently of its color. Also, some persons are intermittently color blind. If they can depend on a uniform location of given lights in the signal case, they can tell what the signal means, even though they are color blind.

Green means proceed along a straight line, and is put at the extreme opposite end of the case from the red so that the color-blind driver may the more readily distinguish it by its location in the case.

The green arrows for right and left turns are suggested because they have been used at several locations in Boston with success for several years. The suggestion of possible use of yellow instead of green arrows is made



FIGS. 2 AND 3—SIGNALS CONTROLLING ALL MOVEMENTS OF A DRIVER

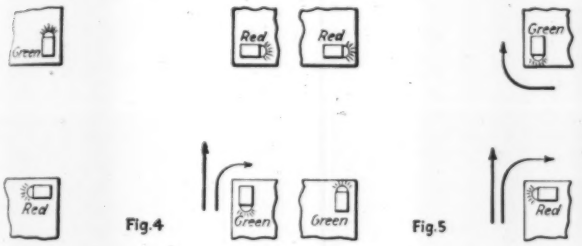


FIG. 4—NEAR-SIDE INSTALLATION PUTS SIGNAL AT STOPPING POINT

FIG. 5—FAR-SIDE INSTALLATION MAKE RIGHT TURN ILLOGICAL

because yellow indicates that the move should be made carefully. The use of the arrowhead takes care of the color-blind driver because it is a "shape" signal the meaning of which is obvious regardless of the color used.

Each intersection should have uniform signal cases or boxes, regardless of whether all the indications are used or not. For instance, where no left turns are allowed, the left-hand arrow space should be there. Its never being lighted never gives the right to turn left. To inform the stranger a plain white frosted lens may be substituted for it with the words "No Left" printed on it in black letters. The use of uniform signal boxes has two advantages. The allowable moves may be altered temporarily for special occasions with very little labor, and a smaller number of spare cases need be kept for repair purposes.

Pedestrians—The plan outlined takes care of the motorist perfectly, but it leaves the pedestrian without help or hope. A system used in Boston is all wrong from a purely theoretical viewpoint as to colors of lights, etc., but it works, and works very successfully. Red and yellow lenses are shown simultaneously in all directions. This stops all auto traffic in all directions and pedestrians may walk in all directions, both square and diagonal, within the limits of the crossing so long as these lights are on. To clear the crossing of pedestrians the yellow light is shut off and the red left on until the last pedestrian is safely ashore. To give these indications requires a case with five lights in it, as shown in Fig. 3.

Location—Uniformity of location of signals is something that the motorist has a right to expect. As it is now, some signals are at the right hand, some are at the left, some are overhead, some are at the point where he is expected to stop and others are a hundred feet more or less beyond that point. To steer a car, avoid the festive jay-walker, give the road hog his due and no more, avoid the novice driver and on top of that to be obliged to look "all over the lot" for traffic lights and then to make up your mind what they mean and obey them, and to do it all in a split second, is almost too much to ask of anyone. It is much more than is asked of the railroad engineman. Installation of the lights all at the same height above the roadway, always on the right-hand side, and *always at the stopping point* will do much to relieve the driver. When you relieve the driver you help to prevent accidents by more than just that much.

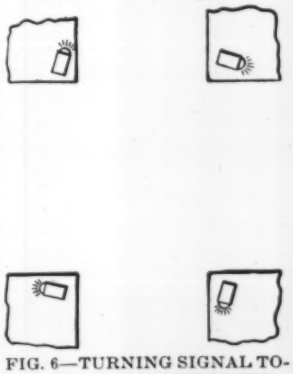


FIG. 6—TURNING SIGNAL TOWARD ROAD INCREASES VISIBILITY

There are several reasons for locating the lights at the stopping point. One of them is best illustrated by diagram (see Figs. 4 and 5). Fig. 4 shows signals located at the stopping point. Fig. 5 shows them located on the far side of the street. To make a right turn it is necessary, with the far side location, to pass the red light. Albany does it in that way. To avoid this illogical movement some cities (Worcester for one) allow cars to make a right turn on the right light, as shown by the arrow, Fig. 5. This is still more illogical, as it makes it impossible for the signal to control or stop anyone desiring to make a right turn. By this procedure the driver has a right to go to the right and pass the stopping point set for other cars regardless of pedestrians and other traffic. These examples indicate how indefensible this practice is. The lights are to control traffic, but the danger or stop signal is rendered of no effect for one desiring to make a right turn.

With signals located on the near right-hand side of the crossing every motorist will stop short of the red light in such a position that he can see when it changes

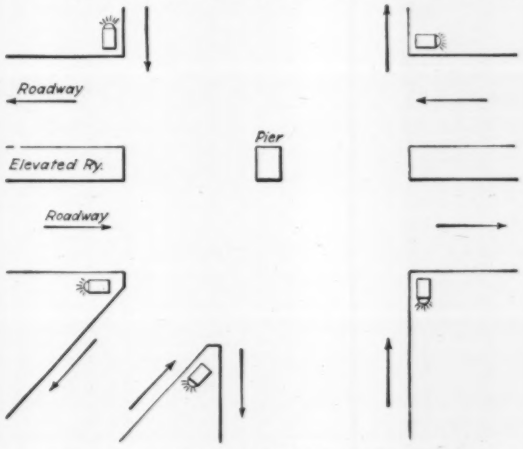


FIG. 7—COMPLICATED CROSSING NEEDS NEAR-SIDE SIGNALS

to a proceed indication. This practice prevents edging up on to the crosswalk, and makes pavement marking (a not negligible item of expense) unnecessary. The objection that parked cars obscure signals on the near side is easily met by not allowing parking within 20 ft. or so of such signals, as is done at fire hydrants.

If desired, the zone of visibility of signals may be increased by using wide-angle lenses and by turning them at a slight angle toward the roadway, as shown in Fig. 6. Wide-angle lenses can be obtained at very little additional cost. They will show with undiminished intensity of light 8 to 9 deg. or a little more either side of the axis. Using such lenses, the axis of the signal may be set at an angle of 10 deg. with the curb line and the light will show with practically undiminished intensity through an angle extending from the curb to a line drawn at an angle of 20 deg. with it. It will actually be visible through a greater angle, but with diminished intensity. Wider angles still can be obtained, but it then becomes necessary to use prismatic lenses, which are rather expensive. Experimental lenses have been constructed that will show through 90 deg., but they are not yet on the market.

Another argument for near-side rather than far-side signals is the impossibility of using an intelligible system of signals at a complicated crossing with far-side signal-

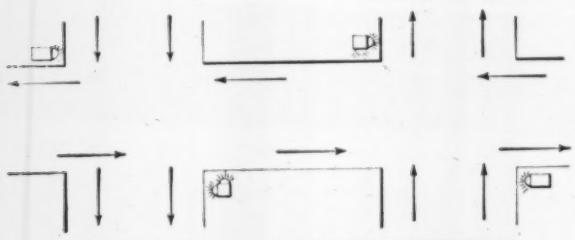


FIG. 8—SIGNALS ON FAR SIDE, LEFT SIDE AND RIGHT SIDE

ing. Fig. 7 shows an extremely congested crossing in Boston. Arrows indicate the directions of traffic on the streets. It is further complicated by an elevated structure overhead. It is necessary to allow turns in all directions. Traffic is heavy. It is unsignaled. This crossing simply could not be signaled by far-side signals, but it could be handled quite readily by near-side signals located as shown.

Fig. 8 is an instance of signals that are not only on the far side of the crossing but are on the left side for one street and on the right side for the other. This is a crossing existing in Boston and is a good example of how *not* to do it.

Conclusions—A logical system of traffic signals should give a positive indication for each one of the four possible movements of the driver as he approaches an intersection, and should also afford positive protection for the pedestrian. Signals should be used to expedite traffic, not merely to check or stop it. Anything that helps the driver should expedite traffic. A fixed order of placing the different lights in the signal box will help every driver and particularly those who are color blind. Uniform locations are a great help to the driver. Signals should be located about 8 ft. high so as to be within the "vision of comprehension" as discussed in the 1925 article previously noted. They should be at the right-hand side of the roadway, and at the stopping point.

Hydrogen-Ion Control Reduces Cost at Small Water Filter Plant

OPERATION of a small water filter plant at Waterford, N. Y., is mainly concerned with the removal of high color, but for a large part of the year *B. coli* in the raw water exceed 5,000 per 100 c.c. Since Feb. 1, 1924, the plant has been operated entirely under hydrogen-ion control, which consists of determining the "optimum point" of the raw water for proper coagulation

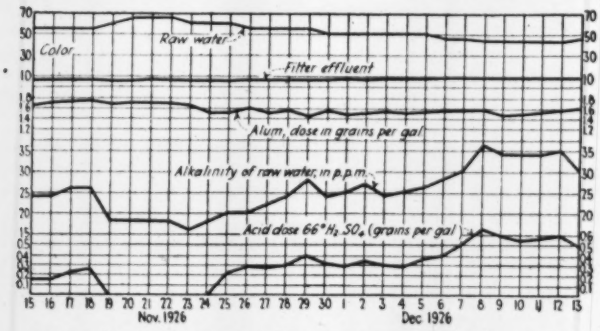


FIG. 1—EXAMPLE OF RESULTS OF OPERATION WITH HYDROGEN-ION CONTROL

Note similarity between graphs of alkalinity of raw water and acid dose used.

and maintaining this pH value by use of 66 deg. sulphuric acid. Among the other beneficial results obtained has been a reduction in the total cost of chemicals, the reduction of wash water by about 4 per cent and the elimination of hydrate in the effluent during the winter months.

Fig. 1 shows the results obtained in routine plant operation during a portion of November and December, 1926. Of particular interest in connection with the study of these curves is the fact that the turbidity of the raw water varied from practically zero to 200, and the temperature from 32 deg. F. to 44 deg. F. Another point of interest is that coagulation can be obtained over a wider range in water conditions, without making any great

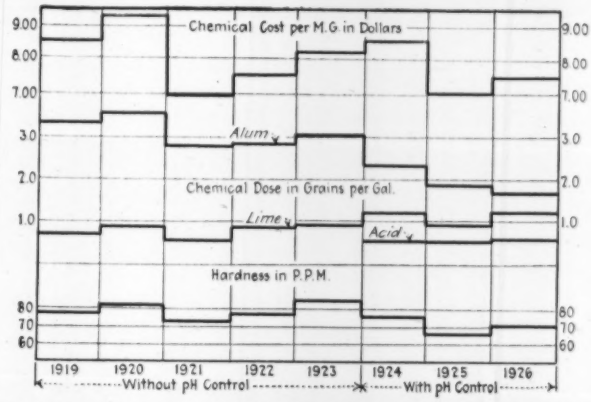


FIG. 2—COST AND ANNUAL RESULTS WITH AND WITHOUT pH CONTROL

For the five years without acid control, the average hardness was 77 p.p.m., as compared with 70 p.p.m. for the three years with acid control. The corresponding costs for chemicals were $8.09 and $7.71 per m.g., based upon the same unit prices for c[illegible] throughout, regardless of actual [illegible] paid.

changes in the amount of chemicals used, by maintaining the pH value at the "optimum point." The pH values of the water in the sedimentation basins varied from a maximum of 6.06 to a minimum of 5.82, with the average at 5.97. The "optimum point" is about 5.95, and as the water is very critical, a change of 0.2, either up or down, will reduce the effective coagulation. Fig. 2 and the accompanying explanatory note show the effect of pH control.

R. G. Yaxley, superintendent of water-works, has had direct charge of the operation of the filter plant since June, 1921.

Railway Construction Progresses in Manchuria

Rapid progress in railway construction was made in Manchuria during the quarter ended September, 1927. The Mukden-Hailung Railway, begun in July, 1925, was completed and the first train was run on Sept. 5. The length of this line is 145 miles. Construction on the Meihoku-Hsian and Hailung Chaoyangchen branches of this railroad, 45 and 11 miles, respectively, was pushed with a view to completing them early in 1928. The track between Changqu and Tungliao was also finished during the quarter, thus completing the Tahushan-Tungliao Railway, 156 miles long. Progress was made on the Kirin-Tunhua line, and the road as far as Liaotaohotzu, 40 miles from Kirin, was planned to be formally opened on Oct. 12. It is said that the summer of 1927 witnessed the greatest railroad construction in the history of southern Manchuria.

Asphaltic Concrete Paving Practice in Denver, Colo.

Black-Base Construction Giving Good Service on More Than a Hundred Miles of Streets Paved in Four Years

IN FOUR YEARS the city of Denver, Colo., has laid more than 100 miles of black-base asphalt pavement. It has, in fact, since Jan. 1, 1924, virtually standardized on this type of street construction except where bad soil conditions or poor drainage have made concrete base more certain or economical. With its sand-loam soil and its generally excellent subsoil drainage most favorable to the success of black base, the city has taken advantage of its low cost compared with concrete base. Now with some 3,000,000 sq.yd. of bituminous streets of all kinds there is 1,892,009 sq.yd. of black base. There are 556,754 sq.yd. of asphaltic concrete and 482,113 sq.yd. of sheet asphalt on concrete base. Of the black base only 100,000 sq.yd. was laid prior to Jan. 1, 1924, and of the 1,038,864 sq.yd. of concrete base only a little more than 200,000 sq.yd. has been laid since Jan. 1, 1924. The radical change of practice is emphatic.

Subgrade Limitations—With the decision in 1924 to carry out an active program of city paving, the engineers were ordered to prepare specifications for an asphalt pavement that would meet the requirements of the districts to be paved. These were largely residence districts and in any case, by the terms of the city charter, the cost of the improvement could not exceed 50 per cent of the assessed value of the abutting property. There was, then, a definite limitation on pavement cost. Economy of first cost had to be carefully regarded. From a study of the city records it appeared that an asphaltic concrete wearing surface on a coarser asphaltic concrete base gave promise of meeting the conditions. This type of construction on alleys paved in 1905 was still in serviceable condition. More important, Speer

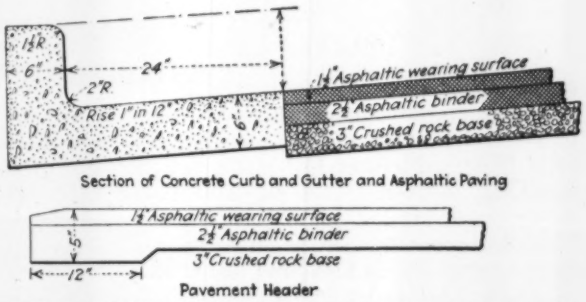


FIG. 1—STANDARD ASPHALTIC CONCRETE PAVEMENT, DENVER, COLO.

Boulevard, paved in 1910, had shown excellent endurance.

It was recognized that subsoil and drainage had an important bearing on the success of the type of construction being considered. In these respects Denver conditions appeared favorable. The soil in general was sand loam, which packed and bonded well and did not hold water. In general, too, the natural subsurface drainage was excellent. Old macadam and stone surfacing had stood up well on this same ground. The important requirement of usable local materials also seemed satisfied. Very hard basalt rock was being quarried within 10 miles of the city. A good grade of rock could also be had from the mine tailings at Cripple Creek. In the city of Denver itself there was suitable smelter slag. These materials had specific gravities respectively of 2.74, 2.45 and 3.50.

On the evidence as indicated, the undertaking of black-base construction appeared justified. At the same time it was realized that in parts of the city with less favorable soil and drainage other construction would have to be employed. Here concrete base has been employed with sheet asphalt or asphaltic concrete surfacing because it has given the necessary stability at less cost. To have

FIG. 2—A DENVER BLACK-BASE PAVEMENT SIX YEARS OLD

secured the same stable foundation with black base would have required extra drainage and removal of the poor soil, replacing it with crushed rock; these operations would have cost more than the extra cost of concrete base. With the decision to standardize in general on black base the next important question to be taken up was that of design.

Pavement Design—The streets in the districts to be embraced in the extensive paving program begun in 1924 were old waterbound macadam or natural soil sometimes lightly surfaced with gravel or stone. On the macadam streets the thicknesses decided on were:

Kind of Street	Base, In.	Surfacing, In.
Heavy traffic (business)	3½	1½
Light traffic (residence)	2½	1½

Where the old macadam was thin, the sub-base was built up with crushed stone. About half a million yards of this design of pavement was laid in 1924, and this is the design still used on macadam streets. For the natural soil or lightly surfaced streets, the design (Fig. 1) is a 3-in. crushed rock sub-base, 2½-in. black base and 1½-in. wearing surface. This is the present standard black-base pavement design of the Denver Department of Improvements and Parks and is the construction considered in the following discussion.

Construction Materials—Stone, crushed gravel or slag is employed for sub-base and for aggregate. For sub-base the material is required to have a hardness coefficient of 8 and to pass a 2½-in. and to hold on a ¾-in. square screen. As binder for the sub-base stone, either crusher screenings or sandy loam is allowed. Screenings have to pass ¾ in., and not less than 40 per cent nor more than 80 per cent may pass a ¼-in. screen.

The mixture required for the black base is:

	Per Cent
Pass 1½-in., held ¾-in.	15 to 45
Pass ¾-in., held ¼-in.	15 to 45
Pass ¼-in.	25 to 40
Asphaltic cement	4.5 to 6

This calls for a stone all passing 1½-in., 25 to 50 per cent passing ¾-in. and all held on ¼-in., and for a fine material which screens as follows:

Passing Screen	Returned Screen	Per Cent
¼-in.	.....	100
¼-in.	10-mesh	0 to 20
10-mesh	40-mesh	15 to 50
40-mesh	80-mesh	25 to 65
80-mesh	200-mesh	7 to 40
200-mesh	.....	0 to 6

The asphaltic cement is a 40 to 65 penetration (at 77 deg. F.) mixture, with a specific gravity of 1.02; flash point, 400; ductility, 40; loss on heating, 2 per cent, and melting point, 124 deg. In brief it is an ordinary good asphaltic cement. The wearing surface mixture called for is as follows:

	Per Cent
Pass ¾-in., held ½-in.	10 to 15
Pass ½-in., held ¼-in.	25 to 35
Pass ¼-in., held 10-mesh	12 to 16
Pass 10-mesh, held 200-mesh	30 to 35
Pass 200-mesh	5 to 7
Asphaltic cement	6 to 8

This calls for a fine material all passing a 10-mesh and a filler all passing 50-mesh and 66 per cent passing 200-mesh. The asphaltic cement is the same as for base mixture. In rating the specification for penetration, "40 to 65 as ordered" the climatic conditions of Denver have to be kept in mind; the variation in temperature is as much as 105 deg., and the annual rainfall is light, 14 to 15 in.

Construction Methods—The success of Denver black-base pavements is due to the precise care given to all construction details. Subsoils and drainage and qualifications for materials have been noted. The construction processes are as closely regulated. The work begins with the natural soil subgrade. This is developed in detail. The normal processes are shaping and rolling as is common practice, but this operation is particularized by searching out weak spots due to poor soil or unsettled trench fill and making them strong by excavation and refilling. With the subgrade at profile the 3-in. stone course is placed and rolled, working from the sides to the center. A three-wheel, 10-ton roller is required. The particular work is the bonding of the rolled stone. This is done with screenings or with the natural sand-loam soil. If screenings are used, they are spread from roadside piles with shovels and in thin layers. Each layer is rolled dry and the work continues until no more screenings can be rolled into the voids. The surface is then sprinkled and rolled again. If the binder is loam, it is spread about an inch deep over the wet and rolled stone, and then is combed or harrowed in and afterward sprinkled and rolled. Often after the sub-base is prepared as described the street is opened for traffic for several days and again reconditioned. The purpose of the traffic test is to disclose weak spots. When about to place the black base, the sub-base is swept with wire brooms, giving it a clean, granular surface which has successfully prevented creeping.

The base-course mixture is mixed in the usual manner, using hot materials, and is transported so as to arrive on the work at 325 to 375 deg. Spreading, raking and rolling conform to usual procedure. Emphasis is, however, placed on thorough rolling—not more than 200 sq.yd. an hour with a 10-ton three-wheel or an 8-ton tandem. Too great compactness, it is stressed, cannot be secured. Substantially the same procedure is followed for surfacing as for base course, but the rolling is two ways instead of longitudinally only. An asphalt flush coat, with a thin layer of stone chips, sand, cement or stone dust rolled in, completes the surface finish. Fig. 2 is a representative black-base pavement.

Engineering Control—Rigid inspection covers every process of constructing black-base pavement in Denver. Both asphalt-plant and street inspection are maintained. The plant inspector records the weight of every truck-load of material on a card which is taken by the truck driver to the inspector on the street. The street inspector marks off the proper area upon which the material is to be spread. The city also has a testing laboratory which makes routine tests of mixtures and samples cut from the pavement.

Conclusions From Experience—From the experience with considerably more than 100 miles of black-base pavement a knowledge of limiting conditions has come. The city's engineers do not wish to be understood to advocate this construction for all streets or roads. It is probable there are towns and localities where it will not fulfill requirements and may be uneconomical. Indeed, this is true of certain streets in Denver. It is believed, however, that in practically all places where subsoil conditions are favorable and where proper drainage can be provided, black-base construction will prove satisfactory and afford economical construction and for a period of at least twenty years maintenance will be virtually nothing. At the end of that period the street can be resurfaced for one-third the original cost and be as good as new.

Direction—Black-base paving in Denver has been under the direction of the Department of Improvements and Parks. A. K. Vickery is city engineer and J. F. Carey is assistant engineer.

Hydro-Power Projects in Eleven Western States

The tabulation of 33 additions to hydro-electric generating plants throughout the eleven Western states in 1927 and 1928 appears in the February issue of *Electrical West*, a McGraw-Hill publication printed in San Francisco. Eleven of the plants are listed as having been completed in 1927 and 22 are now under way or are planned for construction at an early date. Three installations notable as high-head plants have static heads of 2,420, 2,381 and 2,561 ft., respectively. Six other plants having heads exceeding 500 ft. are listed, but not all Western developments are in the high-head class, as several with heads below 50 ft. are included, one of 3,000-hp. capacity being designed for a head of only 16 ft. The first propeller-type runners to be installed in the West were put into service in 1927 at the Black Eagle plant in Montana and two notable automatic plants are listed in British Columbia rated at 12,500 and 17,500 hp., respectively. The largest units are double overhung impulse turbines to develop 56,000 hp. under a head (static) of 2,420 ft., and a reaction unit of notable size and head is the 44,000-hp. turbine to be built this year for a head of 715 ft. (static). Installations of less than 1,000 hp. are not included.

Compressive Stress on Wood Surfaces Inclined to the Grain

Study of Previous Test Results and New Formula Utilizing a Coefficient Which Varies With the Kind of Wood

By William R. Osgood
Assistant Professor, Structural Engineering
Cornell University, Ithaca, N. Y.

THE SAFE bearing strength of wood on surfaces inclined to the grain has commonly been computed by one of the following formulas:

(1) That proposed by Prof. Henry S. Jacoby (Jacoby's "Structural Details," p. 253):

$$n = p \sin^2 \theta + q \cos^2 \theta;$$

or (2) that proposed by Prof. Malverd A. Howe (*Engineering News*, August 1, 1912, p. 190):

$$n = q + (p - q) \left(\frac{\theta^\circ}{90}\right)^{\frac{5}{2}}$$

where n is the allowable compressive stress on a surface which makes the angle θ with the grain, p is the allowable compressive stress parallel to the grain, and q is the allowable compressive stress perpendicular to the grain. It has been shown rather conclusively by tests that the first formula is not safe for most structural timber except for very small angles or for angles close to 90 deg. The second formula is usually in better agreement with the results of tests, frequently in very good agreement for angles up to about 45 deg., but for the larger angles often results in an uneconomical design.

The fundamental weakness in both of the formulas is that they assume the strengths of all woods, on surfaces inclined to the grain, to depend only on the strengths in compression parallel to and perpendicular to the grain. Most tests indicate that there is something else. The author has attempted to take account of this other variable by introducing in a formula a constant which depends on the particular kind of wood being dealt with. The formula is:

$$n = \frac{p}{1 + a \frac{p-q}{q} \cos^2 \theta + (1-a) \frac{p-q}{q} \cos^4 \theta} = \frac{p}{1 + \frac{p-q}{q}\left[a \cos^2 \theta + (1-a) \cos^4 \theta\right]} \quad (1)$$

where n, p, q, and θ have the same significance as before, and where a is a constant of the wood. A study was made of tests conducted at the University of Mississippi (*Engineering News-Record*, Sept. 30, 1920, p. 653), at the California Institute of Technology (*Engineering News-Record*, Nov. 11, 1920, p. 959), and at Cornell University (*Cornell Civil Engineer*, May, 1923, p. 98). From the study of these tests, which were made to determine the elastic limits of wood in directions inclined to the grain, the following tentative values for a were found:

Cypress	0.05
Southern pine	0.35
Redwood	0.45
Chestnut	0.45
Douglas fir	1.55

The results of the tests, together with the corresponding values obtained from the formula proposed by Howe and from the formula proposed by the author, are represented graphically by the accompanying curves.

For Southern pine, redwood, chestnut and Douglas fir the proposed formula is in excellent agreement with the results of the tests. For cypress the agreement is not so good; it may be pointed out that by taking $a = 0$ for cypress the proposed formula gives a curve almost identical with the test curve for angles up to about 60 deg., but for larger angles the former curve will lie somewhat higher above the latter than at present.

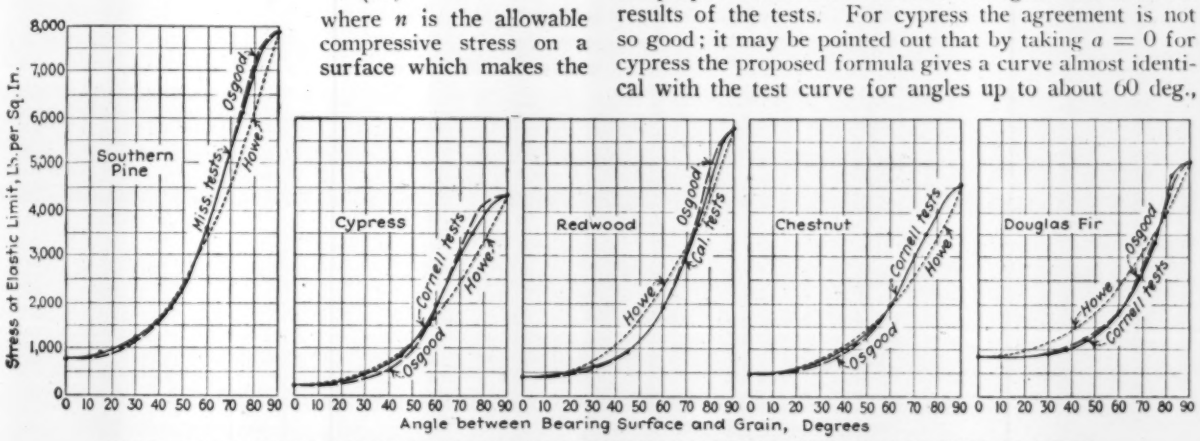


FIG. 1—ELASTIC-LIMIT CURVES FOR VARIOUS WOODS LOADED ON SURFACE INCLINED TO GRAIN
Curves compare results from Howe formula and from the one proposed by the author with values from several test series.

The curve represented by the proposed formula may be raised by decreasing the value of a and lowered by increasing the value of a. The curve has a horizontal tangent at $\theta = 0$ deg. and at $\theta = 90$ deg. To avoid values of n less than q or greater than p, a must not be greater than 2 nor less than 0. The author would suggest that in tests to determine a the elastic limits be investigated for θ equal to 0, 30, 45, 60, 75, 85 and 90 deg.

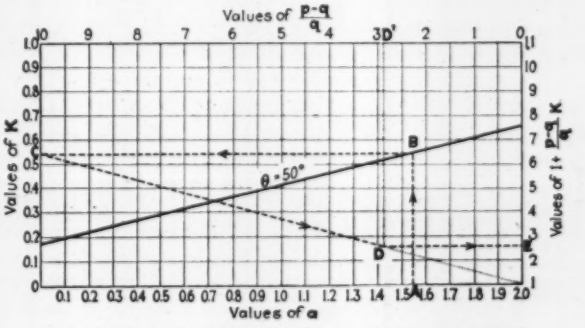


FIG. 2—DIAGRAM SHOWING METHOD OF USING CHART IN FIG. 3

Using the Formula—For purposes of computation it is convenient to write formula (1):

$$n = \frac{q}{1 + \frac{p-q}{q} K},$$

where $K = a \cos^2 \theta + (1 - a) \cos^4 \theta$.

By means of Table I, which gives values of K corresponding to $a = 0$ and $a = 2$ for different values of θ, the chart, Fig. 3, has been prepared for determining K and $(1 + \frac{p-q}{q} K)$ for any given values of a, θ, and $\frac{p-q}{q}$ up to 10. The method of using the chart may be explained best by means of an example, see diagram, Fig. 2. It is desired to find the safe bearing strength of Douglas fir on a surface inclined at 50 deg. with the grain. Let the allowable stresses be $p = 1{,}800$ lb. per sq.in. parallel to the grain and $q = 465$ lb. per sq.in. perpendicular to the grain. With $a = 1.55$, the chart is entered at A, the intersection of the vertical through A with the line $\theta = 50$ deg. at B is noted, and the value of K is found at C. Next, the point C and the lower right-hand corner of the chart are connected by a straightedge or a fine thread, and the point D noted at which a vertical through D', the point on the upper boundary of the chart corresponding to $(p - q)/q = (1{,}800 - 465)/465 = 2.87$, intersects the edge of the straightedge. Finally, the value of $(1 + \frac{p-q}{q} K) = 2.57$ is read at E. The allowable stress n is then found as $p/2.57 = 700$ lb. per sq.in.

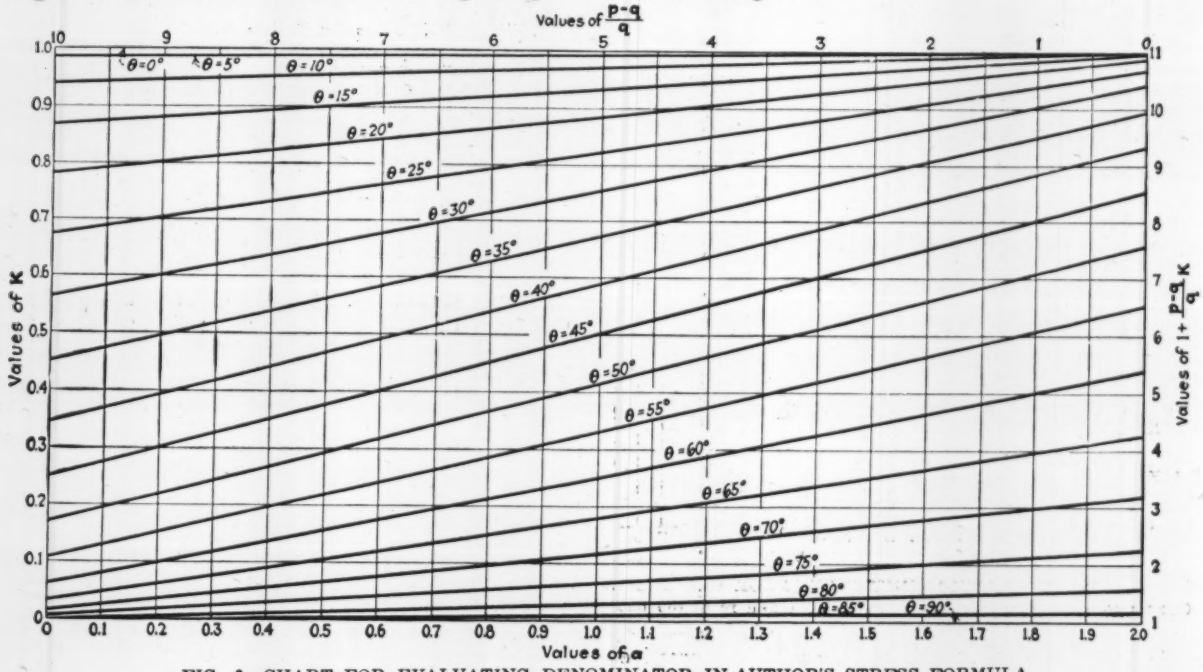


FIG. 3—CHART FOR EVALUATING DENOMINATOR IN AUTHOR'S STRESS FORMULA

TABLE I—VALUES OF K CORRESPONDING TO $a=0$ AND $a=2$ FOR DIFFERENT VALUES OF θ

θ°	0	5	10	15	20	25	30	35	40	45
a=0	1	0.9849	0.9406	0.8705	0.7797	0.6747	0.5625	0.4503	0.3444	0.2500
a=2	1	0.9999	0.9991	0.9955	0.9863	0.9681	0.9375	0.8918	0.8293	0.7500

θ°	50	55	60	65	70	75	80	85	90
a=0	0.1707	0.1082	0.0625	0.0319	0.0137	0.0045	0.0009	0.0001	0
a=2	0.6556	0.5497	0.4375	0.3253	0.2203	0.1295	0.0594	0.0151	0

Rules for Heating Elevated Water Tanks

TO PREVENT freezing of elevated water tanks as used in fire protection service, the National Board of Fire Underwriters, in one of its standard practice publications, recommends circulating hot water in the riser pipe and the tank. It considers steam coils unsuitable except where intermittent heating can be used.

It is recommended that the hot water pipes be placed between the discharge or riser pipe and the frost-proof casing, and be extended up into the tank to a point two-thirds the height of the tank, ending in an open tee. At one-third the height of the tank, a cross should be fitted. The hot water pipe should be at least 2 in. in diameter and of wrought iron.

For the cold water return, a pipe at least 2 in. in diameter should be used, and for long runs of horizontal pipe, 2½- or 3-in. pipe is recommended. The cold water return should be connected to the discharge pipe and fitted with a thermometer, located in a place where it will register the coldest water in the system. A recording thermometer is preferred, although any mercury type thermometer registering accurately will do.

Both the hot water pipe and the cold water return should be fitted with an outside screw and yoke gate valve. Between the hot and cold water valves and as

HEAT LOSS FROM ELEVATED STEEL AND WOODEN TANKS IN B.T.U. PER HOUR.

(When temperature of coldest water is 40 deg. F.)

Compiled from Tables 4 and 5, pp. 92–93, "Regulations for Construction and Installation of Tanks," National Board of Fire Underwriters.

Atmospheric Temp. F.	Tank Capacity in U. S. Gallons: 25,000 Steel	25,000 Wood	50,000 Steel	50,000 Wood	75,000 Steel	75,000 Wood	100,000 Steel	100,000 Wood
0°	185,000	62,000	288,000	106,000	382,000	135,000	460,000	164,000
−10°	238,000	80,000	371,000	136,000	490,000	174,000	592,000	211,000
−20°	296,000	99,000	462,000	169,000	612,000	217,000	738,000	262,000
−30°	341,000	121,000	562,000	206,000	744,000	264,000	897,000	319,000
−40°	431,000	144,000	672,000	246,000	890,000	317,000	1,073,000	382,000
−50°	507,000	170,000	791,000	290,000	1,048,000	372,000	1,261,000	450,000
−60°	592,000	197,000	922,000	307,000	1,221,000	407,000	1,472,000	490,000

near the heater as possible there should be a ¾-in., or larger, relief valve.

The heater capacity is determined by the size of the tank and the minimum atmospheric temperature which is apt to occur. Under actual operating conditions it is recommended that the temperature of the water in the tank be kept between 40 and 50 deg. F. whenever it is possible to do so.

The accompanying table shows the heat loss per hour from elevated steel and wooden tanks of various capacities and at different atmospheric temperatures. According to these figures, a 100,000-gal. steel tank at an atmospheric temperature of 30 deg. below zero loses 897,000 B.t.u. per hour. This amount of heat is equivalent to 75 lb. of the average grade of bituminous coal per hour. When burned in a laundry heater having an efficiency of 50 per cent, 150 lb. of coal per hour would be required to prevent the water in such a tank from reaching a temperature of less than 40 deg. F.

These tank heating data were obtained originally by the inspection department of the Associated Factory Mutual Insurance Companies from actual running tests, as published by this organization in Vol. II, "Specifications for Gravity Water Tanks and Steel Towers."

Tidal Marsh Excavation Aided by Well Points

DURING the construction of the new sewage-disposal plant for the village of Freeport, Long Island, one of the chief problems of the contractor was how to handle the water in the excavations, all of which were located on marsh land subject to tidal overflow and some of which extended to a depth of 15 ft. below the normal groundwater level. On several occasions the tides flooded the excavations. On the two most difficult excavations the contractor resorted to a system of well points, which proved unusually successful. The well points are now

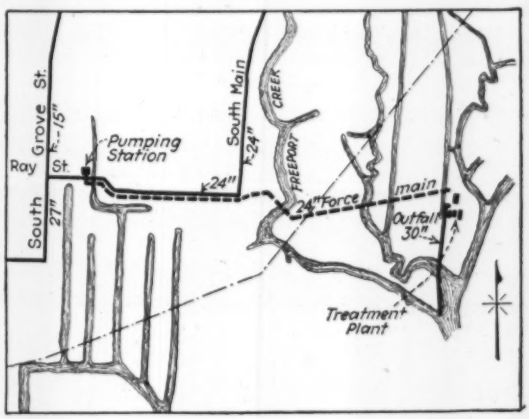


FIG. 1—LOCATION OF PUMP STATION AND TREATMENT PLANT ON TIDAL MARCH

being used to unwater the pipe trenches adjacent to the pumping station.

The sewage-works, designed for a population of 10,000, includes a pumping station and treatment plant, as shown in Fig. 1. At the pumping station, located about 50 ft. from a small creek, the original salt marsh is covered with about 2 ft. of fill; the marsh is 5 ft. thick and is underlain by clean water-bearing sand. At the treatment plant the surface of the marsh is at El.+3.8 M.L.W., and here a muck layer 6 or 7 ft. thick is underlain by a thin layer of gravel on top of very fine compact sand. The groundwater level at both locations changes with the tide, although normal groundwater level ranges between 1 and 4 ft. above low water.

Well point systems were used around the pumping station excavations, 28x48 ft. in plan and extending to a depth of approximately 16 ft. below normal groundwater level and around the sedimentation tanks at the treatment plant 44x86 ft. in plan and extending to a depth of about 14 ft. below the groundwater. At each location the excavation was carried through the muck layer before unwatering was begun. All excavations were made with a clamshell bucket and no sheeting or bracing was used, the sides being given a slope of about 1 to 1.

The unwatering equipment used was the same at each location, consisting of a 6-in. header pipe encircling the area to be excavated and connected through 1¼-in. risers to 90 Moore-type well points driven about 5 ft. below the bottom of the excavation. The water was lowered by an 8-in. centrifugal pump and the level was maintained by a 6-in. pump. On the sedimentation tanks four hours of steady pumping lowered the groundwater to such a level that excavation could start.

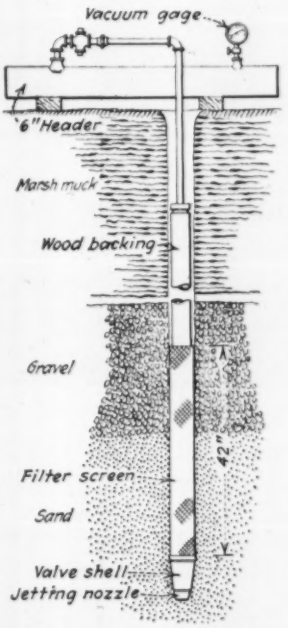


FIG. 2 — DETAILS OF WELL POINTS USED ON SEWAGE PLANT EXCAVATIONS

The type of well point used, shown in Fig. 2, incorporates a special valve shell and a jetting nozzle to assist in its installation. The valve shell contains two floating ball checks. One of these closes during the jetting operation, forcing the water to the end of the point, while the other opens to permit the water to pass out. In operation the lower one is closed, preventing any inflow of sand at the tip, and the upper one is opened, permitting the outside water coming through the mesh to enter the pipe. The mesh wrapping is 42 in. long, and wood backing is used around the remainder of the pipe to assist in easy withdrawal of the points from the ground. For jetting, city pressure at about 60 lb. per sq.in. was used, and as a general rule one to two minutes was sufficient for jetting a point. At the pumping station the sand gave up the water easily, whereas at the sedimentation tank the marsh mud was deeper and the water yield was therefore somewhat less than the capacity of the 6-in. pump, making it necessary to use a vacuum pump to keep the 6-in. pump primed. Except for this, the system worked most effectively and all excavation and concreting work was done in the dry.

The work was carried out by the J. P. White Engineering Company, contractor, of Passaic, N. J., under plans prepared by Nicholas S. Hill, Jr., consulting engineer, New York City.

From Job and Office

Hints That Cut Cost and Time for the Contractor and Engineer

Penstock Wyes Withstand Pressure of 2,230 Lb. Per Square Inch.

IN THE design of the Bucks Creek plant of the Feather River Power Co. in California it was necessary to provide two wyes within the power house at points where the two main penstock lines divide into four pipes of smaller diameter, each leading to the runner of a double overhung waterwheel unit. At the point of bifurcation in each line the penstock has a diameter of 36 in. and the two outlets of the wye are each 26 in. in diameter. Because of the high operating head which puts a pressure of 1,100 lb. per sq.in. on these wyes, special care was used in the design to provide a transition

SHOP VIEW OF TWO WYES FOR BUCKS CREEK PLANT

from main penstock to the branches whose hydraulic form would be as nearly perfect as possible. The form of this transition is shown clearly in the illustration.

Since specifications required that each wye be tested under a pressure of 2,230 lb. per sq.in., all details of the casting were made extra heavy. The two outlet flanges were connected by a heavy strut strong enough to eliminate danger of distortion at that point and thus eliminating the necessity of calculating any stress effects that might result therefrom.

A feature of the design of these wyes is the central web extending inward from the crotch of the two branches to a point just downstream from a through strut bolt. This web acts as a tensional strut supporting the flat surface of the wye and culminating in the strut bolt. This bolt is made of alloy steel, 3½ in. in diameter, and passes vertically through the casting.

In putting the bolt into place it was first kept for some time in boiling water, thus expanding it a definite amount by heating to an accurately predetermined temperature. While at this temperature it was taken from the water, put in place and the threaded circular nuts on either ends of the bolt were immediately drawn up with great care to a specified tension. The contraction that resulted when the bolt cooled was sufficient to compress the metal of the casting between 0.003 and 0.005 in. That is, the distance between the nuts on either end of the bolt was decreased by this amount due to the stresses set up by the contraction of the bolt on cooling. The stress set up in the casting in this way provides an initial resistance of definite value against the bursting stresses due to water pressure when the wye is in service.

The wyes were designed and installed by the Pelton Water Wheel Company, San Francisco.

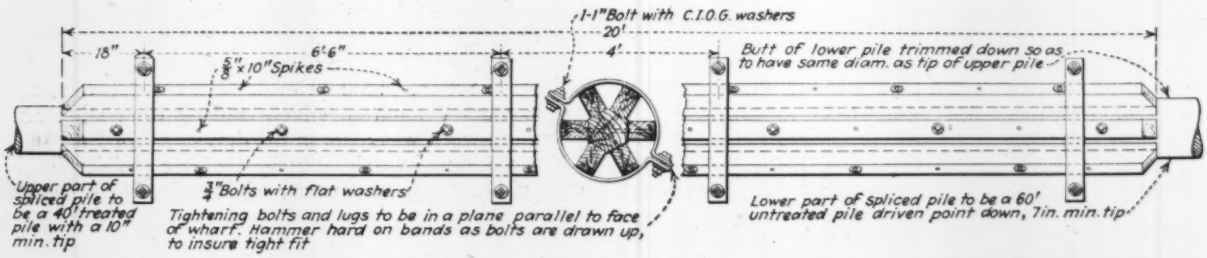
Spliced Piles for 100-Ft. Lengths for Wharf Construction

By Arthur M. Shaw
Consulting Engineer, New Orleans, La.

IN the construction of wharves and other works in the harbor of New Orleans conditions occasionally arise requiring the use of piles of 100 or 110 ft. in length. While it is still possible to purchase piles of such length, it is becoming increasingly difficult to secure them in any number. Deliveries are slow and uncertain and, when obtainable, the piles are certain to be of small diameter at the tip and for a considerable distance back from the tip.

Recently a wharf has been completed by the port authorities for the use of the Todd Engineering, Dry Dock & Repair Company in which a large number of 100-ft. piles was required. An old wharf in the vicinity had been dismantled in which spliced piles had been used. As these splices appeared to be in good condition, the same plan was adopted for the new wharf, but with the addition of four heavy bands clamped on to hold the splicing timbers in place in the event of injury to the bolted connections under heavy driving. The details of the splice are shown in the accompanying illustrations.

As a floating drydock is to be operated alongside of the wharf, requiring a depth of 50 ft. at low water, it is necessary to depend on the front line of piles to serve as columns without lateral stiffening for something over 50 ft. Beginning at an elevation 2 ft. above low water,

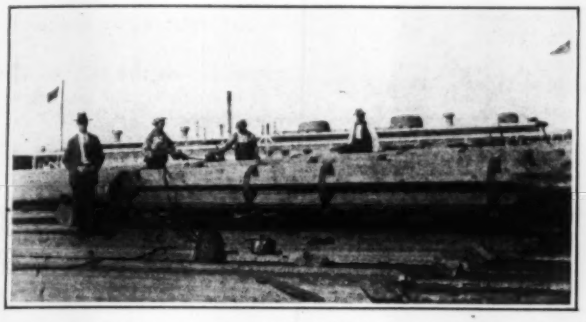

1-1" Bolt with C.I.O.G. washers
20'
18"
6'-6"
4'
⅝" x 10" Spikes
Butt of lower pile trimmed down so as to have same diam. as tip of upper pile
Upper part of spliced pile to be a 40' treated pile with a 10" min. tip
¾" Bolts with flat washers
Tightening bolts and lugs to be in a plane parallel to face of wharf. Hammer hard on bands as bolts are drawn up, to insure tight fit
Lower part of spliced pile to be a 60' untreated pile driven point down, 7 in. min. tip

PILES TO BE SPLICED ARE TRIMMED TO HEXAGONAL SHAPE TO RECEIVE 4X6-IN. SPLICING TIMBERS

the piles were thoroughly braced in all directions and batter piles were driven to assist in holding the whole structure against a possible tendency to move riverward. The upper 20 ft. of the piles was available for this bracing.

The advantages of the spliced piles over those obtainable in single lengths are as follows: (1) Better value of $\frac{r}{l}$, serving as a column; (2) greater strength to resist horizontal stresses; (3) material is more readily obtainable; (4) only two-fifths of each pile need be given creosote treatment, as the remainder is permanently submerged.

That the splice is amply strong was demonstrated



SPLICING AN UNTREATED PILE TO A CREOSOTED TIMBER PILE

when one of the piles was left moored in the river for several days. The heavy creosoted end sank, the tip remaining above water. The sunken end became so heavily loaded with silt that when an effort was made to salvage the pile by hauling on a line attached to the exposed tip, the creosoted portion was broken off immediately beyond the splice, the untreated portion of the pile and the entire splice coming out without any evidence of injury. Also an examination of a considerable number of splices was made by a diver after driving had been completed. He reported all splices in apparent good condition.

The design and construction of the wharf were under the supervision of Samuel Young, chief engineer of the port. The writer is the engineer representing the Todd interests.

Unusual Tank and Tower Structure of Reinforced Concrete

THE ELEVATED tank and tower installation shown in the accompanying illustration has been in service ten years, during which time it has successfully withstood several earthquakes and a number of severe gales. It is located at Patea, New Zealand, and being situated near the seacoast, is subjected to high winds carrying salt spray. The structure was, therefore, built of reinforced concrete, with a tower height of 120 ft., the panels being 30 ft. The tank shell is 15 ft. high with a capacity of 75,000 Imp. gallons.

There are six reinforced-concrete columns 2 ft. in diameter, 12 ft. on centers at the top and 18 ft. 9 in. at the base, the columns being tangential to a parabola. The struts are precast members 10 in. in diameter, while the diagonal bracing consists of 1⅛-in. mild steel rods upset to 1½ in. and provided with turnbuckles, the whole wrapped with wire netting and plastered.

Because the tower rests on a clay foundation about 12 ft. thick overlying saturated sand, the weight was reduced to a minimum, the total weight of the structure and water above the foundations being 630 tons. The tower was built on an annular ring of reinforced concrete 8 ft. wide, 42 ft. in diameter and 3 ft. deep. The columns are subjected to a stress of 630 lb. per sq.in. and a wind pressure of 50 lb. per sq.ft. when the tank is full. The tank, 34 ft. in diameter and with walls 4 ft. thick, is supported on a system of radial and circular girders, the former being cantilevered to support a balcony. In order to reduce the amount of scaffolding during erection, the reinforcement in the columns and girders was made of riveted latticed steel frames fabricated from light angle iron. The cost of the structure was about £4,400. It was built by R. Cornish, contractor, to designs prepared by and under the supervision of H. R. Climie of the consulting firm of H. W. Climie & Son, New Plymouth, England.

CONCRETE WATER TANK

Handling Caissons for Pier Building in New Polish Harbor

By Morrough P. O'Brien

IN THE construction of the new Polish commercial and naval harbor situated on the Gulf of Danzig, the superstructure of the docks and piers rests on reinforced-concrete caissons placed on a layer of gravel and rock and filled hydraulically with sand. These caissons are 59 ft. 9 in. long, 34 ft. 6 in. high, and from 18 ft. 5 in. to 21 ft. 7 in. wide. The bottom thickness of concrete is 1 ft. 8 in., thickness on the water side 2 ft. and on the land side 10 in., with 8-in. interior walls.

Caissons are being cast at a point which will ultimately be in the center of the main entrance to the harbor. Work of placing them is combined with that of dredging. The

CAISSON BEING FLOATED BY REMOVING SAND BENEATH IT

caisson is tipped over and floated by removing the sand from beneath it and is then taken to its position by a tug. The foundation consists of a 2-ft. bed of graded rock ranging from 6 in. in diameter down to small pebbles. After the caisson is in position the thickness of the wall on the water side is increased to 4 ft. As the top of the caisson proper projects only a few inches above the water surface this outer wall is also continued upward 4 ft. and braced by triangular members at each interior and end wall. To provide the anchorage for the hawser bits, the volume between two of these triangular braces is filled with concrete. The caissons are placed with their ends 3½ ft. apart and the joint between them is made by filling this space with plain concrete.

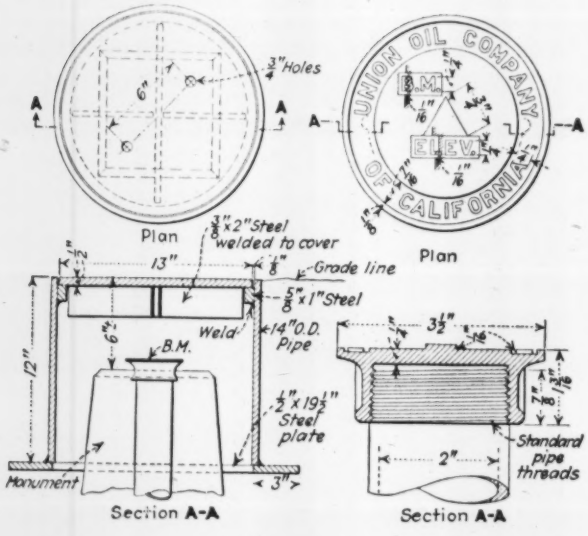
Each caisson is divided into five sections of equal size. The dividing wall has a hexagonal opening 4 ft. on the side, a little above the center. In casting them the exterior form for the water side is placed on the ground and above it precast cement blocks are placed for holding the interior walls. The water side is poured from the interior and the other walls from above. Three-eighths-inch reinforcing steel with a 6-in. spacing is used in both sides of each wall.

The harbor is in the protection of a low-lying sandy spit running out to Hela. It is at the end of the Polish Corridor and about fifteen miles northwest of the Free City of Danzig. The project calls for approximately 6½ miles of concrete docks and 16,000,000 cu.yd. of dredged material.

A Combination Survey Monument and Bench Mark

MONUMENTS marking survey points of a more or less permanent nature and to which frequent reference must be made should be both substantial and convenient, and to attain a high standard in these particulars the Union Oil Company of California has worked up designs for a permanent monument and marker, as shown in the accompanying drawings.

The monument proper is made with a 1:2:3 concrete mix poured in the form of a square, tapering shaft extending about 2½ ft. below the ground surface. In paved streets the monument is set with its top about 6 in. below the grade line and elsewhere the top projects about



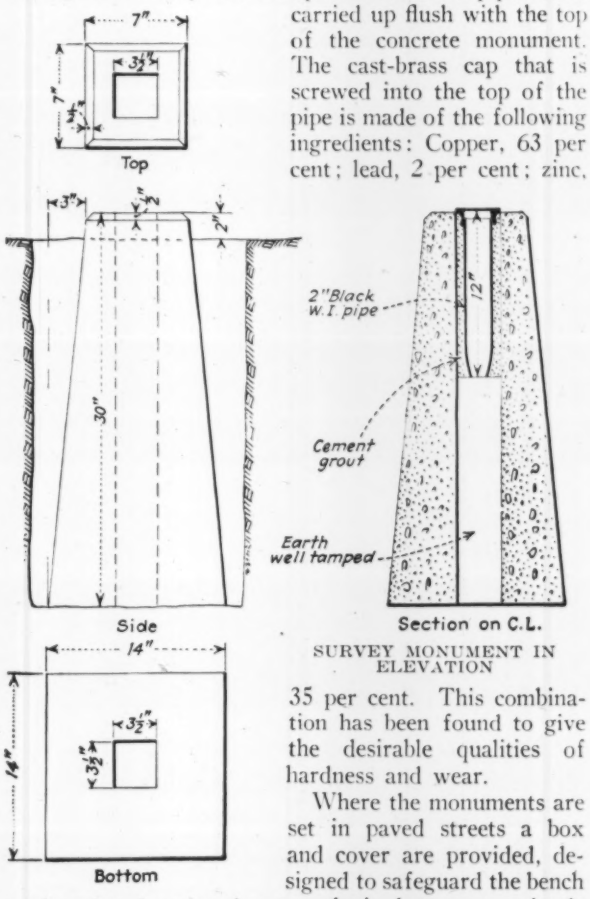
DETAILS OF SURVEY MONUMENT AND BENCH MARK

From Job and Office

Hints That Cut Cost and Time

2 in. above the adjacent ground surface. After pouring, the monuments are kept moist and shaded for at least seven days. The weight of the concrete required is about 300 lb., or 2.05 cu.ft. The shaft has a core hole or hollow center in which is installed a 2-in. pipe grouted in place and threaded at its top to receive the brass cap which constitutes the bench mark.

The lower part of the core hole is filled and well tamped with earth before the pipe is put in and grouted. This grout entirely fills the space around the pipe and is carried up flush with the top of the concrete monument. The cast-brass cap that is screwed into the top of the pipe is made of the following ingredients: Copper, 63 per cent; lead, 2 per cent; zinc, 35 per cent. This combination has been found to give the desirable qualities of hardness and wear.



SURVEY MONUMENT IN ELEVATION

Where the monuments are set in paved streets a box and cover are provided, designed to safeguard the bench mark and at the same time to make it always conveniently accessible. The walls of this box consist of a 12-in. length of 14-in. standard pipe set vertically and provided at the top with a cover and at the bottom with a flange. The cover consists of a ½-in. circular plate, 13 in. in diameter, on the under side of which ⅜x2-in. flat steel bars have been welded. This cover rests on a ⅝-in. steel ring welded around the inside of the 14-in. pipe just below the top. The collar at the bottom of the box consists of a ½-in. circular plate 19½ in. in diameter whose center has been cut out to provide a hole of size convenient for the top of the monument to pass through.

A ¼-in. hole in the center of the raised triangular marker in the brass cap can be used either by plumb bob or in connection with a light flagpole set up to accurately mark the station as a back sight. For this purpose a nail is driven into the bottom of the pole and allowed to project about an inch. The nail is then inserted in the

From Job and Office

For Contractor and Engineer

hole in the brass cap and the pole guyed in a vertical position by wires or cords.

Monuments of this type, which are used to mark permanent survey points on the properties of this company, were developed under the supervision of Ralph J. Reed, chief engineer, Union Oil Company of California.

Intake Well Forms Sand Catcher

THE shore well on a new intake pipe in Lake Michigan, built in 1926 for the water supply of Michigan City, Ind., is designed to act as a sand catcher, being fitted with baffles and screens to intercept sand which is coarse enough to settle in comparatively still water. To determine the best arrangement of the baffles, experiments were made on a model of 1:12 scale, Fig. 1. It was necessary to force sand in suspension in larger quantities than exist under natural conditions in order that the deposits could be noted and the work done in reasonable time. This experimental work was carried out by Russel B. Moore, resident engineer for Charles Brossman, Indianapolis, Ind., consulting engineer for the city. The following account is condensed from a paper read by Mr. Brossman before the Indiana section of the American Water Works Association and supplemented by later information.

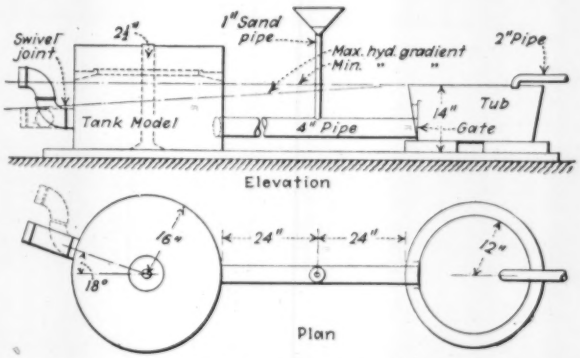


FIG. 1—MODEL FOR INTAKE-WELL EXPERIMENTS

A 2-in. pipe delivered water at city pressure to a galvanized-iron tank, which was allowed to overflow so as to maintain a constant head on a 4-in. pipe leading to the sheet-iron well. A gate was placed at the head of this pipe, but its position had little effect on the results. A vertical 1-in. pipe tapped into the 4-in. main carried a hopper from which beach sand was introduced into the stream of water. A swiveling 4-in. elbow for the outlet enabled the outlet to be changed so as to vary the hydraulic gradient.

With the model well free from baffles, water was allowed to flow through and red ink was poured into the sand hopper. The path of this tinted water through the tank, at high and low hydraulic gradient, was as shown at the left in Fig. 2. With the elbow then set for the mean hydraulic gradient, sand poured into the hopper took the path shown at the right of Fig. 2 and was deposited mainly on the inlet side.

With the baffles arranged as at *A* in Fig. 3, it was evident that to effectively retard the flow through the well the water should be forced towards the left side. When the goose-neck outlet was suddenly lowered, the narrow opening between the baffles was not sufficient for the discharge and sand was carried through the outlet, being picked up from the bottom of tank by the swirling water through the two small openings between the long baffles. The long baffles were then spread as at *B*, with a 6-in. narrow opening where an end baffle prevented sand being carried to the outlet. With this arrangement the sand was distributed more evenly, while the 6-in. opening in the V-baffle was sufficient for the increased flow when the outlet was lowered.

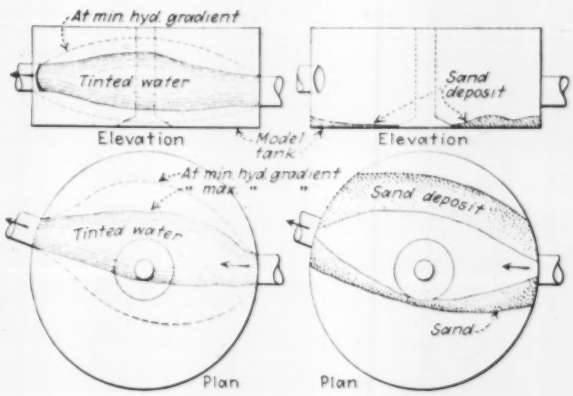


FIG. 2—FLOW THROUGH WELL WITHOUT BAFFLES

The baffle on the inlet side was then changed as at *C*, but the 2-in. opening at its right was too small, while the 8-in. opening at its left was too large. However, it approached the desired result of drawing the sand towards the sides, where it could be handled by the sand pumps. After trial with a modified arrangement, *D*, a compromise between *C* and *D* was adopted, with results as shown at *E*. With low velocities, the sand would settle under the inlet and toward the middle of the well; but with higher velocities it would collect at the sides and against the end of the V-baffle.

In the well as now built, 32 ft. in diameter and 30 ft. deep, the two openings at the inlet side are 4 ft. and 7 ft. wide, with a hinged gate at the end of each baffle for adjustment of the flow. According to Wade W. Swasick, city engineer, the amount of sand entering the mains diminished to a marked degree after the well was put in operation.

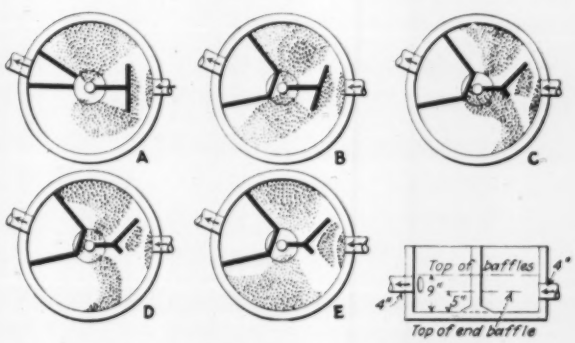


FIG. 3—ARRANGEMENTS FOR BAFFLES
Adopted design shown at E.

Letters to the Editor

A Forum for Discussion of Views of Engineers and Contractors

Wall Castings for Cast-Iron Pipe

Sir—On p. 1017 of your issue of Dec. 22 there is an article entitled, "Wall Castings for Cast-Iron Pipe," regarding which I would like to make a few comments.

This type of fitting was not included in the fittings standardized by the American Water Works Association and for a number of years these fittings were considered special and made for each separate job. At the time the Cast Iron Pipe Research Association prepared its new Handbook, these fittings up to 24 in. in diameter were standardized and are shown on pp. 194 and 195 of "The Handbook of Cast Iron Pipe." In our standardization, we have adopted a uniform working length of 30 in. Provision of fittings with different lengths for each different thickness of wall would mean a multiplicity of patterns that in my opinion would serve no useful purpose.

Another thing in the article that may be misleading is a statement that these fittings are made to Class B dimensions. There is no Class B fitting. The American Water Works Association specifications require that for pipe from 4 to 12 in. inclusive, fittings be made to Class D dimensions. For sizes above 12 in., both Class B and Class D fittings are provided for.

Chicago, Ill., Dec. 23. THOMAS F. WOLFE,
Research Engineer, Cast Iron Pipe Research Association.

Land Values in the Mississippi Valley

Sir—With reference to Mr. De Berard's articles entitled "Today in the Mississippi Valley," his informant regarding the profits of country banks in the delta areas in the vicinity of Memphis, Tenn., was certainly wrong in advising you that few of these country institutions pay less than 20 to 30 per cent dividends. Generally it is undoubtedly true that these country banks do not pay any dividends at all and have not for several years. On the other hand, the stockholders in nearly all these banks have been required to pay in additional capital on account of bad loans and frozen assets.

The first article, concerning land values and the fluctuation of those values, is about correct. Four years ago I tabulated and made a study of the price of these lands and have made a similar investigation recently. I inclose a summary of the result.

H. N. PHARR,
Chief Engineer,
St. Francis Levee District.

Bridge Junction, Ark.,
Dec. 30, 1927.

MISSISSIPPI RIVER ALLUVIAL BOTTOM FLOOD-PROTECTED FARM PRICES

On Sunday, Jan. 6, 1924, the *Commercial Appeal*, a morning newspaper of Memphis, Tenn., advertised, as usual, farming lands for sale. Twenty-five of these farms gave the prices asked and were located in the flood-protected area of the Mississippi River alluvial bottoms lying in Missouri, Arkansas and Mississippi. The total area of these 25 farms was 13,698 acres, of which 52 per cent, or 7,173 acres, were in cultivation and 48 per cent, or 6,525 acres, were woodland. The average size of these farms was 547 acres, with 284 acres in cultivation and 263 acres in woodland. The price asked per acre varied from $15 to $125. The average price was $58.65 per acre—for cultivated land about $90 and for woodland about $25 per acre. On that part of the land in cultivation the improvements were fairly good, as were the drainage, accessability and other conditions and conveniences.

About four years later, on Sunday, Dec. 18, 1927, the same newspaper advertised for sale twenty of these flood-protected alluvial farms, lying in Arkansas and Mississippi, giving the prices asked. No Missouri farms giving prices asked were advertised in this issue. The total area of these twenty farms was 15,450 acres, of which 64 per cent, or 9,870 acres, were in cultivation and 30 per cent, or 5,580 acres, were in woodland. The average size of these farms was 772 acres, with 493 acres in cultivation and 279 acres in woodland. The price asked per acre varied from $15 to $80. The average price was $47.09 per acre—for cultivated land about $65 and for woodland about $16.20 per acre. The conditions and conveniences were fairly good and similar to those on lands previously mentioned as having been advertised in January, 1924.

By a comparison of these two advertisements of alluvial farming lands for sale separated by a period of about four years and immediately preceding the present time it is seen that the average price of these farms has decreased for that part in cultivation from about $90 per acre to $65 per acre and for that part in woodland from about $25 per acre to $16.20 per acre. These prices indicate a general decrease of about 30 per cent in the value of the lands during this four-year period. Probably a considerable part of this decrease may be attributed to the depressing influence of the great flood of 1927.

How Does Shade Affect Ditch Maintenance?

Sir—The cost throughout the United States of drainage districts, designed primarily to serve agricultural needs, exceeds $450,000,000. In these districts there are more than 110,000 miles of open ditch and 45,000 miles of tile drains. The question of maintenance of these ditches is a serious financial and agricultural problem, and any investigation that may lead to lowering the cost would seem worth while. We believe the problem is one of sufficient economic importance to warrant study.

One of the most serious problems of ditch maintenance is the growth of aquatic and semi-aquatic vegetation, which impedes the flow and has a tendency to form floatage rafts and silt deposits.

In some instances it has been noted that where trees are so located with respect to the ditch banks and the dry-season flow line as to give sufficient shade, very little or no growth occurs in the water. The flow line is often completely free from vegetation, but above and below the sections of the ditch so shaded aquatic vegetation oftens runs rampant.

Undoubtedly there are many irrigation or drainage ditches where the machinery necessary for economical cleaning would make tree shading impractical, but on the other hand there must be thousands of miles of ditch where this would not be a factor; also, damage to near-by crops must not result from such shade as large trees would produce. The amount of shade required would probably vary, as would the tree or shrub best suited to various sections and climates in the several states. The amount of dead leaf material falling annually from deciduous or evergreen trees may be a factor to consider. The distance of the trees or shrubs from the bank in relation to ditch depth, size and soil characteristics may influence results obtained. Tree or shrub spacing and time necessary to produce growth may enter. These and many other factors may have to be considered.

In states where malaria is or may be present, such ditch treatment may prove a vital factor. In the aquatic, semi-aquatic and other vegetation, as well as in the rafts of floatage held or temporarily anchored by young trees in the wet bed of the ditches, production of mosquitoes capable of producing disease often takes place in such numbers as to be of serious sanitary importance. In those ditches where the edges and bed of the ditch below the water line are free of this material or condition, there is seldom found production of the malaria type of mosquito (*Anopheles*). Drainage, primarily designed for the improvement of a district, may, through the production of malaria, become the means of preventing such improvement.

The U. S. Department of Agriculture, on Aug. 2, 1926, stated that it had made no particular investigation of this subject. S. H. McCrory, chief of the division of agricultural engineering, stated, however, "I have observed old ditches in heavily timbered country where there was only a small

amount of undergrowth and the ditches were not obstructed to any great extent by it."

Alfred Garkill, state forester of New Jersey, in a letter dated Oct. 25, 1919, to James E. Brooks, consulting engineer of the New Jersey Mosquito Extermination Association, said in part: "My trip with you yesterday to the Great Piece Meadows served to establish the fact that you have recognized the operation of a biological law along the waterways. . . . The law simply is that comparatively few plants of any kind and almost no aquatic plants will flourish in shade. You are therefore entirely right in assuming that if the ditches and other waterways can be sufficiently shaded you will have little difficulty in keeping them open."

Is there not here a field for study and experiment by the engineer, the agricultural interests, and the health interests, all working toward the same end?

Notes, observations, photographs, experiences, theories, all would be valuable in making a beginning and would be welcomed by the committee on engineering of the National Malaria Committee, of which the writer is chairman.

Court House, Memphis, Tenn.

J. A. LePRINCE,
Sanitary Engineer,
U. S. Public Health Service.

[The National Malaria Committee is an organization of volunteer workers who are interested in the control and elimination of malaria from the United States. Besides Mr. LePrince, other members of the committee on engineering are as follows: L. L. Hidinger, Morgan Engineering Company; G. L. Hazlehurst, chief sanitary engineer of the Alabama State Board of Health; S. H. McCrory, chief of the division of agricultural engineering, U. S. Department of Agriculture; Thorndyke Saville, professor of hydraulics and sanitary engineering, University of North Carolina; H. A. Van Havenberg, chief of the department of sanitary engineering, St. Louis & Southwestern Railway Line.—EDITOR.]

Against Mole Ditching for Drainage

Sir—The writer has read with much interest Raymond Olney's excellent article, "Engineering in Agriculture," in your issue of Jan. 12, p. 58. It is a most gratifying sequel to an article by the writer in *Engineering News-Record* of June 24, 1926, p. 1018. In one or two particulars, however, the writer finds it difficult to bring himself into agreement with the views expressed by Mr. Olney.

It is by no means conceded by all who specialize in agricultural land reclamation that the scope of their labors should be arbitrarily limited to the relatively simple problems of the individual farm. Nor does it seem that such hair splitting is necessary. It would appear from a study of recent reclamation history, in the fields of both humid drainage and arid irrigation, that many mistakes in connection with ill-advised projects might have been averted had the supervising engineers been better posted on the agricultural requirements necessary to subdue the raw land and bring it into production.

It is unfortunate that Mr. Olney should have mentioned "mole ditching" as one of the standard practices in farm drainage. The writer has yet to find a single engineer specializing in drainage who will indorse the practice or even permit it on any but the most exceptional projects where abundant fall is available. Some arguments against it are:

1. The soil around the periphery of the opening is tightly compressed, thus rendering it less permeable.

2. When tile are dragged behind the "nose," one or more might be crushed without being detected.

3. Constant attention on the part of the most skillful operator is necessary to insure even approximate adherence to a uniform grade.

4. Inspection and checking of completed work are physically impossible.

5. Savings in cost, however great, are insufficient to compensate for the serious hazards involved.

On the other hand, if a farmer should wish to experiment with machines that mash longitudinal and lateral holes in the subsoil of his fields without attempting to place tile therein, there is nothing to prevent his doing so. But let's call it, for the present at least, a speculative venture rather than a project in engineering.

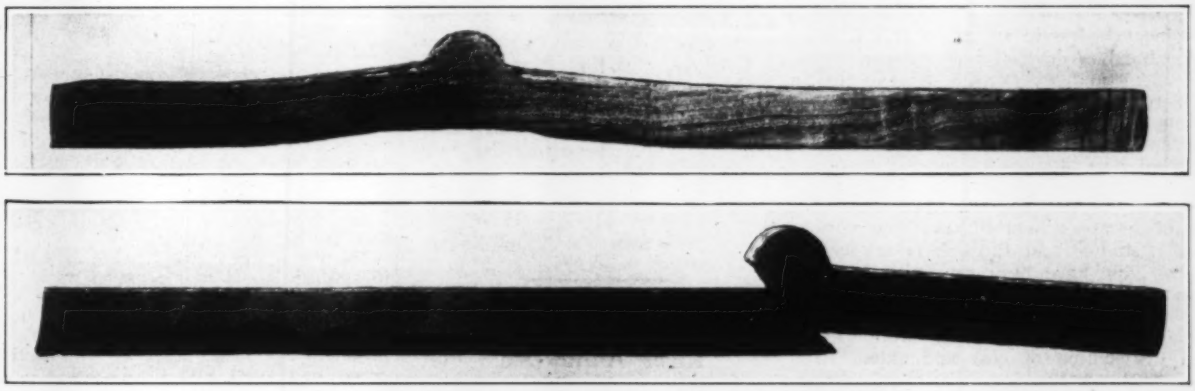
Ames, Iowa, Jan. 19.

Q. C. AYRES,
Iowa State College.

Buckling of Columns at Protuberances

Sir—The usual formulas for the strength of columns indicate that an increase in the cross-section of the column increases the resistance to buckling. But certain experiments performed by the writer primarily for their geological significance indicate that this conception requires modification, as fracture or buckling occurred in certain blocks where they were the thickest. The significance of these experiments is to indicate that irregular protuberances may actually be a cause of weakness.

Blocks about 16 in. (40 cm.) long horizontally, $\frac{3}{4}$ in. (2 cm.) high, and 2 to $2\frac{1}{2}$ in. (5 or 6 cm.) wide, having transverse ridges about $\frac{5}{8}$ in. (1.5 cm.) high and $1\frac{1}{4}$ in. (3 cm.) wide were made of a homogeneous mixture of paraffin and vaseline. Compression was applied in the direction of the long dimension of the block and at right angles to the ridge. In three out of four cases deformation was localized at the ridge, twice resulting in buckling and once in fracture, as shown by the accompanying views. The localization of the deformation at the ridge probably was due to the asymmetry of the stresses caused by the asymmetry of the cross-section of the block.



FAILURE OF TWO COLUMNS AT LOCAL PROTUBERANCES

Small columns 16 in. long, made of paraffin and vaseline; failure under endwise compression. Upper column buckled at protuberance, lower column sheared diagonally at corresponding point.

The distribution of the stresses in the column is approximately uniform across the section of the straight part of the column, but at the protuberance the line of pressure is greatly eccentric, which causes a large increase of stress at one edge of the cross-section here. This probably accounts for the localization of buckling and fracture in the foregoing experiments.

Chicago, Jan. 4.

ROBERT WESLEY BROWN.

News of the Week

Current Events in the Civil Engineering and Contracting Fields

Engineer Committee Recommends Further Flood Relief Study

Committee of Engineering Council Reports on Plans and Advises More Data Are Needed

JOHN R. FREEMAN, Arthur E. Morgan, Gardner S. Williams and Baxter L. Brown, acting as a committee of Engineering Council to report on the Mississippi River flood-protection plans of General Jadwin and the Mississippi River Commission respectively, have just reported that insufficient data are available to warrant the laying out of a permanent plan of flood protection at present, and that the fuller development of a plan calls for extensive further study. Their report was presented to the commerce committee of the U. S. Senate in its hearings on the subject of flood control late last week.

ESSENTIAL FINDINGS

Essential findings of the committee are: (1) That the recommendations for flood protection do not rest on a sufficiently adequate knowledge of the underlying facts to make them dependable; (2) that the cost of the recommended plans may exceed the estimates of the Mississippi River Commission by at least as much as these estimates exceed those of the Chief of Engineers; (3) that a Mississippi River conservancy board of five or seven members of eminent hydraulic engineers should be appointed to develop a solution of the problem and to execute it; (4) that emergency work should be carried out immediately; (5) that every possible means for Mississippi River control should be examined thoroughly before a decision is reached; (6) that no diversion channel plan should be adopted until the areas involved have been more fully studied and the effects of such diversions have been determined; (7) and that a thorough economic survey of the affected region should precede the adoption of a plan and the determination of distribution of cost and extent of improvement justified.

The committee also finds that for the purpose of the Mississippi River work the program of topographic mapping provided for by the Temple Act should be pushed as rapidly as possible and that a hydraulic laboratory or laboratories to aid in the solution of flood problems should be placed under control of research scientists with conditions that will insure continuity of effort through the years.

Up-river states are acquitted of responsibility for adding to or measurably affecting the Mississippi River floods. Reforestation is described to be impracticable as a relief measure, though control of erosion is held to be worthy of consideration for other reasons. The possibility of making useful application of storage reservoirs on the remote headwaters of tributaries for flood control is considered out of the question.

Finally, the committee recommends that flood-control work by the federal government should not be made to depend on the commerce clause of the Constitution or on the government's responsibility for general welfare, but should be grounded on a new constitutional amendment. This should be so drafted as to confer upon the federal government authority to control and administer the national waters and to assess damages and allocate benefits and costs in connection therewith. Only by procedure under such authority, says the committee, can an equitable distribution or allocation of costs of river improvements and flood protection be assured.

Technical Procedure Committee of Am. Soc. C. E. Appointed

The following have been appointed members of the committee on technical procedure of the American Society of Civil Engineers by President Bush, by authorization of the board of direction at its recent meeting in New York:

Lincoln Bush, chairman; George W. Fuller, George T. Seabury, Charles H. Paul, Arthur E. Morgan, F. E. Turneaure and the chairmen of the technical divisions. Of the latter only five have been named: City planning, C. E. Grunsky; construction, W. J. Barney; sanitary, Robert Spurr Weston; structural, J. J. Yates; surveying and mapping, William Bowie.

A preliminary outline of the work of the committee was given in *Engineering News-Record*, Jan. 19, 1928, p. 126.

Power Plant on Connecticut River Authorized

Construction of two dams, a canal, a lock and a power house on the Connecticut River near Windsor Locks, Conn., by the Northern Connecticut Power Company has been approved by the Federal Power Commission and a license has been issued to the company. The Power Commission finds that the proposed power development will make full use of the potential power on the section of the river affected and will be of benefit to the interests of navigation. The company proposes to install 49,800 hp. in hydro-electric units.

Gorman, Chicago Sanitary Engineer, Refuses to Resign

Scores Thompson Administration and the Civil Service Commission in Answering "Charges"

INFORMED by Loran D. Gayton, city engineer of Chicago, that he was slated to go as an "administrative measure" when given 35 minutes to resign on Dec. 31, 1927, or else be suspended on "charges," Arthur E. Gorman, for four years chief sanitary engineer, Chicago Department of Public Works, with special charge of the safety of the city water supply, notified the local Civil Service Commission that he would neither go on "trial" or tender his resignation. The commission ousted Mr. Gorman on Jan. 30. Mr. Gorman stated:

To be discharged by a Civil Service Commission composed of high-minded persons acting honestly in accordance with the civil service law, would, of course, be a serious matter. To be discharged by a Thompson-appointed Civil Service Commission is rather a recommendation. It suggests to all decent, right thinking people that the employee so discharged possessed sufficient manhood and independence to prevent his becoming a mere cog in a machine operated essentially for political, rather than municipal purposes. . . . This action on my part will enable you to enter promptly and without delay the same order that you would finally enter if this trial were dragged out as long as the pending McAndrew trial.

As to the "charges" against him Mr. Gorman said in his letter to the Civil Service Commission:

When I was first suspended I was unable to learn what the charges were against me. No one seemed to know. The specifications now submitted are so vague that I can only guess at the things to which they are intended to relate.

The first charge is that I lacked the qualities which would enable me to work in harmony with those with whom I came in contact and that this has hampered the proper functioning of the Bureau of Engineering. My long record of service of nearly four years with the United States Government and my record of complete and successful co-operation with Dr. Bundesen and Colonel Sprague for three and one-half years furnishes the best answer to this charge. I admit my inability to work in harmony with persons whose chief concern is political manipulation. I am a sanitary engineer and this is the only profession in which I have been educated. I find myself unable to appreciate or adjust myself to the newer idea that has come into the engineering service since the advent of the Thompson administration.

The second charge against me is that I have neglected my duties by delegating important responsibilities to others, particu-

larly the regulating of chlorine dosage in the treatment of water. The only person to whom this work has been delegated, is H. H. Gerstein, assistant sanitary engineer. This gentleman is a highly educated technical official who was particularly trained by me in this work for two years before he was put in immediate charge of it. Even then the sole responsibility was not put upon him because I continued in conference with him every day and supervised his work. The absurdity of the present charge is best demonstrated by the fact that after my suspension the commissioner of public works put Mr. Gerstein in charge of the regulating of chlorine and he is at this moment doing this work, and because of his training and intelligence, and the lack of such training and intelligence in his superiors, is, in fact, now solely responsible for it. As long as he is left free to discharge this responsibility without the meddlesome intervention of some incompetent political henchman as his immediate superior, the public health will be properly safeguarded. Already, however, rumors are afloat concerning the "temporary" appointment to be made to the civil service position I now hold. This "temporary" appointment if renewed every sixty days can and will last just as long as the administration wants it to last.

The third charge against me is that I was instrumental in wasting the funds of the city by discarding equipment that was functioning properly and replacing it with other equipment at great cost. When I was first appointed I made a report on the condition of the chlorinating equipment in use and equipment required to give an adequate reserve to assure public health safety during emergencies. The equipment was badly corroded and it was questionable whether it could be economically repaired and rebuilt. Certain officials of the operating division wanted to re-build the old equipment on a day labor basis, but investigation showed conclusively that this would be practically as expensive, and not nearly so good, as new equipment. Furthermore, notice was later served upon the commissioner of public works by the holders of patents upon the original equipment that they would regard the rebuilding and repairing of it as an infringement. An opinion was sought by Colonel Sprague [then Commissioner of Public Works] and received from the then corporation counsel who in conjunction with one of the leading firms of patent attorneys in Chicago advised him that the position taken by the manufacturers was sound and that the city would risk the possibility of incurring large damages if it attempted to rebuild the equipment. The manufacturers offered to take the old equipment in at a very fair price, and any one who is familiar with the transaction and in a position to give an honest opinion upon it, must admit that the substitution of new equipment was far more economical than it would have been to have rebuilt the old.

Colorado Health Board Publishes Revised Laws and Rules

The Colorado State Board of Health has just published a 278-page revised edition of its health laws and rules. Sections of this book covering, respectively, sanitary engineering, plumbing, vital statistics, and foods and drugs, have been reprinted in separate pamphlets, available upon request.

Dr. Cline Honored by People of New Orleans

IN RECOGNITION of his work in the recent Mississippi flood, Dr. Isaac M. Cline, local meteorologist in charge of the U. S. Weather Bureau in New Orleans, was recently presented with a silver amphora vase by the New Orleans Board of Trade, the Association of Commerce, the New Orleans Cotton Exchange and the New Orleans Steamship Association, in the names of their organizations and the people of New Orleans. On the vase was engraved the following:

To Dr. Isaac M. Cline by the citizens of New Orleans in grateful appreciation of his outstanding service resulting in the preservation of life and property during the flood in 1927.

During the flood Dr. Cline forecast with great accuracy the progress of the rising waters.

Proposed Subordination of N. Y. State Architect to Lay Commissioner Opposed

A delegation of architects, engineers and others interested in the architectural activities of the state of New York, appeared at a hearing on Feb. 7 before the Committee on Reorganization of State Departments at Albany to oppose two bills now before the state legislature. One of these seeks to confer upon the State Department of Public Works the duties of the former Fine Arts Commission, and the other reduces the state architect to the status of a commissioner of architecture to be appointed by and be subordinate to the Superintendent of Public Works. Assemblyman F. L. Porter, chairman of the committee, presided.

The speakers stressed the value to the state work of having the state architect an independent department head rather than a subordinate to a lay commissioner of whom no technical attainments are required and who might be quite incompetent to judge of architectural matters. Prevailing practice in the handling of private work was cited as constituting a safe guide for the conduct of state work and emphasis was laid upon the necessity for a competent and independent head for the extensive architectural program of the state.

Definite suggestions were made that the committee recommend the restoration of a state architect and architectural department reporting to the governor, and that a Fine Arts Commission be re-established either as originally constituted or modified as to scope and responsibility.

Secretary of State Moses spoke briefly in rebuttal. He emphasized especially the economy of time in the carrying out of public works effected by the elimination of the Fine Arts Commission but did not offer argument in behalf of the measure to abridge the authority of the state architect. Those who spoke included the following: Joseph H. Freedlander, president, the Fine Arts Federation of the state of New York; Albert S. Bard, also of the Federation; J. Monroe Hewlett, regional director, the American Institute of Architects; Albert H. Hopkins, president, the Buffalo Chapter, American Institute of Architects; Charles B. Myers, the New York Chapter, the American Institute of Architects; F. B. Byington, chairman, the Producers Council; A. L. Brockway, Central New York Chapter, the American Institute of Architects; William Chevalier, New York Section, American Society of Civil Engineers; Hubert Dunning, Brooklyn Chapter, American Institute of Architects; R. E. McGahen of the Citizens Union.

Engineers Protest Limitation of State Architect's Responsibility

The board of directors of the New York Section, Am.Soc.C.E., has adopted a resolution protesting to the committee on reorganization of state departments against the bill introduced in the New York State Senate the effect of which would be to subordinate completely the division of architecture to the department of public works.

The resolution declared that subordination of the functions of a technical division to a non-technical department violates the principle that a technical bureau should be in complete charge of design and construction, is wrong in principle and has not worked well in practice. Furthermore, it says, passage of the bill would not serve the best interests of the state, because it would lead to deterioration in the character of design and construction of public buildings and remove a salutary check on the department of public works.

Dr. Michael Pupin Receives Washington Award

In recognition of his great contributions to science and civilization by discoveries and developments in electrical engineering, the Washington Award for 1928 has been presented to Dr. Michael Pupin. The presentation was made in Chicago on Feb. 2 by R. F. Schuchardt, chairman of the Washington Award Commission, at a dinner given in honor of Dr. Pupin. This annual prize was founded in 1917 by John W. Alvord, consulting engineer, Chicago, for presentation to engineers who have rendered pre-eminent service in promoting the public welfare. After the purpose of the award had been explained by Rufus W. Putnam, president of the Western Society of Engineers, there was an address on "Mathematics and Invention," by Dr. Max Mason, president of the University of Chicago, followed by other addresses by A. N. Talbot, William Kelly, John L. Harrington and Bancroft Gherardi, representing the four national societies of civil, mining, mechanical and electrical engineers respectively.

North Carolina Engineers Adopt Code of Practice

At the eleventh annual meeting of the North Carolina Society of Engineers, held in Raleigh, N. C., on Jan. 27 and 28 in conjunction with the North Carolina section of the American Society of Civil Engineers and the Raleigh section of the American Society of Mechanical Engineers, the proposed code of practice and schedule of minimum fees which has been under consideration for the past year was unanimously adopted. It is expected that the code will hereafter govern in all engineering work undertaken in the state. Copies of the code, with revisions made at the convention, were ordered printed for distribution.

The society looks with disfavor on the professional tax of $25. This tax, since it is held by the department of revenue to apply only to civil and mechanical engineers, was held to be unfairly discriminative.

Officers elected were: President, Charles E. Waddell, Asheville; vice-president, T. S. Johnson, Raleigh; secretary-treasurer, A. L. Hooper, Raleigh.

Brush Nominated for President of A.W.W.A.

The nominating committee of the American Water Works Association has selected W. W. Brush, chief engineer of the Department of Water Supply, Gas & Electricity, for president for the year 1928-29. The other officials proposed are: Vice-president, Jack J. Hinman, Jr., associate professor of sanitation, University of Iowa, Iowa City, Iowa; treasurer, George C. Gensheimer, secretary, Commissioners of Water Works, Erie, Pa.; trustees, C. D. Brown, Walkerville, Ont., Stephen H. Taylor, New Bedford, Mass., and John Chambers, Louisville, Ky.

Work Starts on New Toll Bridge Over San Francisco Bay

Having secured the approval of the U. S. War Department and a 50-year franchise from the San Mateo County board of supervisors, the San Francisco Bay Toll Bridge Company has announced the start of construction on a 7-mile vehicular toll bridge across the south arm of San Francisco Bay. The new bridge will be about 12 miles north of the Dumbarton bridge, put in service in 1926, and will traverse 6 miles of shallow bay and a deep bay channel about 1 mile wide. The deep-water section will consist of steel trusses with a lift span over the ship channel. Approaches will be concrete trestles with all precast units. The bridge is to accommodate three 9-ft. traffic lanes and is to be completed in June, 1929. The Raymond Concrete Pile Company, of New York, is the general contractor. Waddell & Hardesty are consulting engineers for the bridge company and A. W. Deuel is resident engineer. Project previously noted Oct. 13, 1927, p. 609.

House Committee On Flood Control Ends Its Hearings

Senate Committee Member Insists Plans Be Reviewed by Non-Military Engineers

By Paul Wooton
Washington Correspondent

SENATOR HAWES, of Missouri, is insisting in no uncertain terms at the flood-control hearings before the commerce committee of the Senate that engineers in civil life be given an opportunity to pass on the reports submitted by General Jadwin and by the Mississippi River Commission. General Jadwin in response declares that his plan is based on the work of 150 engineers, 120 of whom are civilians. Through their contacts these men, he declares, have weighed the views of large numbers of the engineers most familiar with the problems presented in river and harbor work. Because of the experience of the Corps of Engineers in handling $50,000,000 worth of river and harbor work annually he argues that the men in his organization constitute the best qualified group in the country to report on the Mississippi flood control problem. John F. Stevens previously had told the committee that there was no use to set up an advisory committee, as the Chief of Engineers of the army would not call upon them for advice. Senator Hawes presented to the committee 167 telegrams mostly from engineering schools, asking that outside engineers be consulted before a flood control plan is accepted. The telegrams were sent in response to one sent by Senator Hawes which was characterized by Senator Willis, of Ohio, as "adroit" and calculated to elicit such a reply from men interested in obtaining jobs for themselves and for their alumni.

Would Abolish Commission

General Harry Taylor, former Chief of Engineers, went even further than General Jadwin and urged the abolition of the Mississippi River Commission. He also urged the Senate committee to be on its guard against the Campbell bill, which he declared to be an effort among certain contractors to increase the level of prices for doing government work.

Hearings before the House Flood Control Committee have been concluded. Fourteen of the 21 members of the committee favor the assumption by the government of the entire expense of project works. Four members insist upon local contributions. The remaining three favor some compromise between the two positions. While the majority of the committee favors an enlarged Mississippi River as the agency for directing the project, there is no disposition to await an outside study of the two engineering reports before reporting a bill. The majority report in the main will favor the engineering scheme outlined in the comprehensive plan of the Mississippi River Commission. The minority report will be based on the Jadwin plan.

THE Senate Committee on Agriculture has reported favorably the Norris Muscle Shoals resolution. It provides for the sale of the power and the use of the receipts to carry out the purposes of the original act which is to use the project in peace time in an effort to produce fertilizer at lower prices. The resolution provides for the construction of experimental fertilizer plants at Muscle Shoals and elsewhere. Operation of the existing nitrate plant "would be the height of folly and useless expenditure of public funds" when the power necessary to operate nitrate plant No. 2 would be six times that necessary in a modern plant. Four members of the committee voted against the Norris resolution. The chief objection is the opportunity it offers for the embarkation of the government in the power business. The resolution authorizes the Secretary of War to construct transmission lines. While this ostensibly is for the purpose of making it possible to secure competitive bids for the power, it is looked upon by some as the entering wedge for government operation in the Tennessee Valley.

A FAVORABLE report on the Swing Boulder dam bill was ordered Feb. 3 by the Committee on Irrigation and Reclamation of the House of Representatives. The committee specified, however, that the text of the report is not to be filed prior to March 15. This action was taken so as to give the seven states directly interested another opportunity to reach an agreement among themselves. A minority report will be filed by Representative Douglass, of Arizona. Additional minority views will be filed by Representative Leatherwood, of Utah; Representative Allgood, of Alabama; and Representative Winter, of Wyoming.

Extension of Union Pacific Is Authorized

The Interstate Commerce Commission has authorized the Union Pacific Railway to construct an extension of its North Platte branch in western Nebraska and eastern Wyoming. The proposed line will extend from Creighton, in Goshen County, Wyoming, southerly about 54 miles to a point in the vicinity of Egbert, 10 miles west of the Nebraska border and about 30 miles east of Cheyenne, Wyo. The proposed line is an offshoot of the North Platte branch, 8 miles long, authorized in 1926.

The order of the Interstate Commerce Commission specifies that construction shall be begun on or before March 1, 1928, and completed by the end of August, 1929. The estimated cost of the road, including 52.8 miles of single main track and 6.22 miles of side and secondary track, is $2,698,968.

Brief News

RECEIVERS OF THE CENTRAL VERMONT RAILWAY have been authorized by the Interstate Commerce Commission to issue $5,000,000 of certificates of indebtedness, the proceeds to be used in repairing damages done to the property of the railroad by floods. The certificates are to be sold at not less than 99.53 and interest. The receivers asked for offers to purchase certificates, and two bids were received, the best bid being that made by Dillon, Read & Company, of New York City.

TO RECONSTRUCT THE FEDERAL-AID SYSTEM of highways in the State of Vermont damaged by the flood of November, 1927, a bill has been introduced into Congress which would authorize appropriation of $2,654,000. This is the estimate of the Burreau of Public Roads for the cost of replacement of federal-aid highways. Testimony was given before the House committee on roads last week that the loss in only three Mississippi Valley states—Arkansas, Mississippi and Louisiana—exceeded Vermont's total of approximately $25,000,000 for all flood damage.

AUTHORITY TO BUILD A 20-MILE RAILWAY line from Chester, Va., on the Seaboard Air Line Railroad into the Hopewell district is sought by the Prince George & Chesapeake Railway Company of Norfolk, Va., from the Interstate Commerce Commission. The railroad after construction would be acquired and operated by the Seaboard Air Line.

AN ENGINEERING TOUR THROUGH EUROPE, with college credit if desired in industrial engineering and mechanical engineering, is offered by the School of Foreign Travel, Inc., of New York City. The party will sail from New York on July 14 and return on Aug. 24. The tour is designed for factory and public utility executives, instructors and students in engineering colleges. Visits will be paid to typical factories and plants and conferences will be arranged with representative European engineers and factory executives. Instruction will be given throughout the entire tour.

THE FEDERAL PUBLIC BUILDINGS PROGRAM, as authorized by a bill passed by the Senate on Feb. 6, calls for the expenditure of an additional $250,000,000. The measure passed the House Dec. 19. Of the amount thus authorized, not more than $50,000,000 is to be expended in the District of Columbia.

UNVEILING OF A TABLET in commemoration of the work and sacrifices of Col. David Du Bose Gaillard, engineer in charge of the excavation of the Panama Canal cut that bears his name, took place on Feb. 4. The tablet, placed high on the rocky face of Contractors' Hill, contains a bas-relief of two heroic figures in bronze, representing laborers welding pick and shovel, with a power shovel in the background.

Railroad Resumes Operation in Flood-Ravaged Vermont

THE first Central Vermont Railway train between St. Albans, Vt., and White River Junction since the recent New England flood was run on Feb. 4. For 90 days 200,000 persons in that region had been without rail transportation, and the arrival of the train was the signal for rejoicing in every town through which it passed. At Montpelier there was an official reception at which Gov. Weeks paid warm tribute to the determination and energy of Vermonters in surmounting the disaster and to the railroads, which had reconstructed in three months a line that seemed disrupted beyond repair.

The train arrived at White River Junction, the end of the ravaged sector, a little before 5 o'clock, for the final reception of the day. It had passed over 117 miles of track that was in such condition three months ago that many Vermonters had dispaired of ever seeing it in use again.

C. F. W. Felt, Chief Engineer of Santa Fe, Dies

Charles F. W. Felt, chief engineer of the Atchison, Topeka & Santa Fe Railway System, died in Colorado on Feb. 4 while on a year's leave of absence taken on account of ill health. He was born at Salem, Mass., in 1864, and began work with the Atchison, Topeka & Santa Fe Railway in 1886 as axman and rodman. In 1888 he went to the Denver & Rio Grande Railroad, but returned to the Santa Fe System in 1890 as resident engineer on the Gulf, Colorado & Santa Fe Railway, where he became division engineer in 1893 and chief engineer in 1896. He was then chief engineer of the eastern and western lines of the A., T. & S. F. Railway successively, and finally in 1913 became chief engineer of the entire Atchison, Topeka & Santa Fe Railway System.

He was prominent in the affairs of the American Railway Engineering Association, and was president in 1926 (*Engineering News-Record*, March 18, 1926, p. 464). He was a member also of the American Society of Civil Engineers and the Western Society of Engineers.

Ponchartrain Bridge to Be Opened Feb. 18

The Ponchartrain bridge at New Orleans will be formally opened on Feb. 18 with appropriate ceremonies. This bridge is the longest all-concrete highway trestle in the world, being 15.41 miles long. A record has been set in its construction, more than 1,000 ft. being finished each week.

Railway Use of Treated Timber Is Conspicuous at Wood Preservers' Meeting

Railway developments in the use of treated timber were made conspicuous at the annual meeting of the American Wood Preservers Association, held at Montreal, Canada, Jan. 24-26, with an attendance of about 300 members and visitors. The economy of framing ties and structural timbers before treatment was discussed by Earl Stimson, chief engineer of maintenance of the Baltimore & Ohio Railroad, who pointed out that the railways are the largest users of treated wood. Reduction of annual tie renewals to less than 100 per mile for several years on the Delaware, Lackawanna & Western Railroad was attributed by George J. Ray, chief engineer, to these causes: (1) Creosoting all ties for both new construction and maintenance, including white oak, (2) purchasing good ties and giving them a heavy treatment, (3) using screw spikes and large tie-plates, (4) boring and adzing all ties before treatment. Statistics of tie service records were presented by a committee, while another committee reported on the use of treated timber in car construction and repairs. At the annual dinner, specific reference to the economic value of treated timber in railway service was made by Lord Shaugnessy, of the Canadian Pacific Railway, and Sir Henry Thornton, of the Canadian National Railways.

Creosoted timber construction for barges on the Mississippi River was dealt with by H. A. Thompson, superintendent of plant for the Fourth Mississippi District of the U. S. Engineer Department. This district has its own creosoting plant and several barges now 28 years old are expected to have a life of 35 to 40 years. Field and weathering tests of treated wood were outlined by P. J. Howe, construction engineer for the Western Union Telegraph Company.

Officers for 1928 are as follows: President, H. R. Condon, Century Wood Preserving Company, Pittsburgh, Pa.; vice-presidents, H. E. Horrocks, Pacific Creosoting Company, Seattle, Wash., and C. C. Cook, maintenance engineer, Baltimore & Ohio Railroad, Baltimore, Md.; secretary, H. L. Dawson, Chicago. The association, which has now 732 members, will hold its next meeting at Louisville, Ky., in January, 1929.

Construction Division Association to Meet in New York

The annual convention of the Construction Division Association will be held in New York on Friday and Saturday, Feb. 10 and 11. The program includes business meetings on Friday at the Hotel Commodore, night club outing Friday evening, business meetings and a brief ceremonial Construction Division Legion Post meeting on Saturday, with a dinner and dance at the Biltmore Hotel on Saturday night.

Engineering Research Fostered by Florida Society

A committee on engineering research, composed of the department heads in the school of engineering of the University of Florida, has been created by the Florida Engineering Society. At its January meeting the board of direction made available an annual award of $100 to that senior student in the university's engineering school whose thesis contributes the most to Florida engineering and engineering research, the award to be made by the committee on engineering research in accord with rules previously defined.

The annual meeting of the society will be held on April 19, 20 and 21 in Jacksonville.

California Undertakes State Park Program

An act passed by the California Legislature last year created the division of parks as a branch of the department of natural resources. The division of parks is to be the means of making a survey of the present situation and formulating a forward-looking program for the acquisition and management of state parks. To meet the expenses of getting the survey started $15,000 was appropriated for the first year's work; $25,000 was appropriated for two years' expenses of the park commission (in addition to the usual funds for park upkeep) and a bond issue of $6,000,000 was authorized "to enable the commission to acquire as part of the California park system such land and other properties as, in the judgment of the commission, shall be suitable for that purpose." Approval of this bond issue, which must be by popular vote, is to be asked for at the election this fall. The position of the commission was materially strengthened by the right to condemn property, this right being conveyed by the creative act.

The commission proper is composed of five men selected because of training and experience, who serve without pay. They are W. E. Colby, chairman, R. L. Wilbur, W. F. Chandler, Major F. R. Burnham and Henry W. O'Melveny. If the $6,000,000 bond issue is approved, expenditures from this fund will be available only when matched by equal amounts from some source other than state public funds.

During the first year the work of the commission will be carried on under two general divisions: (1) A survey of proposed acquisitions such as landmarks, historical monuments and other properties will be in charge of F. L. Olmsted, and (2) Charles B. Wing, whose retirement from the faculty of Stanford University is announced elsewhere in this issue, will be chief of the division of parks and executive officer of the commission. Colonel Wing's duties will be to work out and put into effect a connected plan for the development, operation and management of existing and future park properties.

Throne Speech, at Canadian Parliament Opening, Silent On St. Lawrence Waterway

The speech from the throne at the opening of the Canadian Parliament on Jan. 26, announcing the policy of the government, contained no reference to the St. Lawrence Waterway project, to the surprise of the public, which had been led to expect a definite declaration on the subject. The government has had before it for some time the report of the National Advisory Committee dealing comprehensively with the matter, and many public bodies have urged the government to take immediate action.

One feature of that report has met with strong objections in Ontario, as it contains the suggestion that before carrying out the main project permission might be accorded to private interests to develop the large amount of power available in the St. Lawrence rapids. Public opinion in this province is in favor of public ownership and development of water-power resources and regards this recommendation as looking to an infringement of provincial rights. Despite the omission of the question from the government program, it is certain to come before Parliament at an early date, as Montreal financial interests have already made application for permission to develop power on the St. Lawrence. The provincial government of Ontario claims the ownership of all power resources within the boundaries of the province.

Premier Ferguson of Ontario stated that the absence of the subject in the speech was a surprise and a disappointment, as the people wanted immediate action. The recommendation of the advisory committee appears to be that the dominion government should arrogate to itself the right to deal with provincial property, but the provinces of Ontario and Quebec were agreed, and would have the support of the other provinces in insisting that the water-power rights belong to the provinces. The premier contended that the question should be submitted to the Supreme Court and carried to the Imperial Privy Council so as to obtain delimitation of federal and provincial jurisdiction over water-power resources.

25-Ft. Ship Channels Proposed for Lake Ports

A bill has been introduced into the House of Representatives to provide for ship channels 25 ft. deep at low water for Lakes Erie, St. Clair, Huron, Superior and Michigan. This bill also includes the connecting waters and the harbors of Buffalo, Cleveland, Toledo, Detroit, Duluth and Milwaukee and a harbor in the vicinity of Chicago. The Secretary of War is authorized to contract for this work. The ship channels are to extend from the entrance of the Welland Canal to the harbors provided for in the measure.

Hydraulic Survey Committee Plans Work

C. M. Allen, chairman of the survey committee of the Hydraulic Division of the American Society of Mechanical Engineers, announces that the committee is now organized to begin its survey of hydraulic research both in this country and abroad. Upon completing its survey the committee will recommend to the division projects for research that it considers most important.

Annual Welding Conference at University of Wisconsin

The annual welding conference at the College of Engineering of the University of Wisconsin is being held on Feb. 8, 9 and 10 under the auspices of the department of mechanical engineering and the university extension division of the university in co-operation with the manufacturers of welding and cutting equipment. The program includes papers and discussion on the progress and problems of the art by men prominent in the industry.

Many Canadian Bridges Proposed

Bridge legislation will occupy much of the time of the forthcoming session of the Canadian Parliament. Three groups of capitalists are fighting for a charter to build a bridge across the St. Clair River from Sarnia to Port Huron —the International Transit Company, the St. Clair Transit Company and the Port Huron & Sarnia Bridge Company.

Two companies are contesting for a charter to erect a bridge across the gorge of the Niagara River below the Falls—the Niagara Falls Memorial Bridge Company and the Niagara Gorge Bridge Company. The Thousand Island International Bridge Corporation has served notice that a bill authorizing construction of a bridge across the St. Lawrence between Brockville and Gananoque will be introduced again this session. A similar bill was introduced in 1927 and was killed by request of the government.

The most interesting bill, however, comes from F. A. D. M. Morgan, of Montreal. He will have a bill introduced incorporating the Montreal Western Canal Company and empowering it to construct the greater St. Lawrence waterways, concerning which the government is now carrying on an investigation. The bill states that the company shall dredge a 30-ft. water channel "so as to make and complete, throughout the entire distance from the harbor of Montreal to Cornwall, navigable canals and ship channels as deep as may be found necessary to enable ocean-going vessels to meet and pass in safety at any point." The bill also binds the company to build a bridge over the St. Lawrence from Valleyfield to Coteau Landing, and gives the company all water powers available on the whole stretch of the river.

Personal Notes

SOLOMON M. SWAAB, formerly consulting engineer to the Mayor of Philadelphia, has opened offices for general consulting practice in the Bankers Trust Building, Walnut and Juniper Sts., in that city.

MACKLIN MACK, zoning board engineer of Indianapolis, Ind., during the coming year will also hold the post of city plan commission engineer. The latter post has been held by J. Ray Monaghan, who has been dismissed in order to keep the city payroll within the 1928 appropriation.

JOSEPH W. SHIRLEY, engineer formerly at the head of the Bureau of Plans and Surveys, Baltimore, has been retained by the Baltimore Municipal Art Society as an adviser to help that organization formulate its program for the beautification of the city. Mr. Shirley was in the city service for 33 years.

CHARLES B. WING, executive head of the department of civil engineering, Stanford University, on Feb. 1 began a sabbatical year's leave of absence which he will spend as executive officer and chief of the newly created division of parks in California. Under the Stanford rule, limiting period of service, Professor Wing would be retired automatically next year, so the present move is understood to terminate his 36 years of active service in that institution. During the war Professor Wing served in France as a Lieutenant-Colonel of the 23d Engineers and in recent years has carried on a consulting practice, particularly in bridge and structural work. He has taken an active interest in state park development and for fifteen years served on the California Redwood Park Commission as vice-chairman.

NATHAN W. MORGAN, of Washington, D. C., of the bridge division of the Bureau of Public Roads, has been on a special assignment to the Vermont flood area since last November. Mr. Morgan is a graduate of the University of Colorado, and has recently completed a series of typical steel bridge designs for the bureau. In his present assignment he is assisting the state in the preparation of bridge designs.

EDGAR B. THOMAS has joined the contract department staff of the H. K. Ferguson Company, international engineering and building firm with headquarters in Cleveland, Ohio. Mr. Thomas is chairman of the Cleveland Chamber of Commerce rivers and harbors committee, vice-president of the National Rivers and Harbors Congress and of the Great Lakes Harbors Association, past president of the Cleveland Engineering Society, and a member of the American Society of Civil Engineers. For the past fifteen years Mr. Thomas has been engaged in general engineering practice and building construction. While city engineer of Cleveland he supervised construction of the East Ninth St. passenger piers on Lake Erie. He has studied harbor problems in many parts of the country, notably the Chicago water diversion and the St. Lawrence and Cuyahoga River improvements. He is a graduate of Muskingum College and the civil engineering department of the Case School of Applied Science.

Engineering Societies

Calendar

Annual Meetings

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Montreal, Feb. 14-16, 1928.

ASSOCIATION OF HIGHWAY OFFICIALS OF NORTH ATLANTIC STATES, Trenton, N. J.; Annual Convention, Atlantic City, N. J., Feb. 15-17, 1928.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Convention, Philadelphia, Feb. 28, 29 and March 1, 1928.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Convention, Chicago, March 6-8.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, May 7-10.

AMERICAN WATER WORKS ASSOCIATION, New York; Annual Convention, San Francisco, week of June 11.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION; Annual meeting, University of North Carolina, June 25.

THE AMERICAN SOCIETY OF CIVIL ENGINEERS and the American Society of Mechanical Engineers, San Francisco sections, held a joint meeting on Jan. 26 at which Dr. W. F. Durand discussed "Some Problems of the Colorado River." Dr. Durand, who was appointed last year on a federal Colorado River commission, presented the results of first-hand study of storage, water supply, power, silt and irrigation problems.

THE INDIANA ENGINEERING SOCIETY at its recent annual meeting, noted in *Engineering News-Record* Feb. 2, page 210, elected officers os follows: President, Frank C. Wagner, Terre Haute, Ind.; vice-president, Clifford I. Harrod, Indianapolis; secretary (re-elected), Charles Brossman, Chamber of Commerce Building, Indianapolis, Ind.

THE PROVIDENCE ENGINEERING SOCIETY will hold its twelfth annual banquet in the Providence Biltmore Hotel, on Wednesday evening, Feb. 15. James L. Clark will tell of thrilling adventures in quest of big game in central Asia; Father John Sullivan, chaplain of the aviators during the World War, will tell stories of that conflict; and Dr. Harrison E. Howe will talk on "Science and the New Competition."

THE ASSOCIATION OF ASPHALT PAVING TECHNOLOGISTS, at its annual meeting in Cleveland, Ohio, on Jan. 12, elected the following officers: President, Leroy M. Law, New Orleans; vice-president, Walter J. Emmons, Ann Arbor, Mich.; second vice-president, Prevost Hubbard, New York City; secretary-treasurer, Charles A. Mullen, Montreal.

THE NEW YORK STATE HIGHWAY CHAPTER, Associated General Contractors of America, will hold its annual meeting at the Syracuse Hotel, Syracuse, N. Y., on March 14 and 15.

THE INDIANA SECTION OF THE AMERICAN WATER WORKS ASSOCIATION announces that its twenty-first annual meeting will be held at Purdue University, Lafayette, Ind., on March 15 and 16. The program is being planned especially in the interests of operators of water-works plants. C. K. Calvert, 1902 North New Jersey St., Indianapolis, Ind., is secretary.

Obituary

WILLIAM C. L. EGLIN, vice-president and chief engineer of the Philadelphia Electric Company and president of Franklin Institute, died at Philadelphia on Feb. 7, following an illness of a few weeks. Dr. Eglin was born in Glasgow, Scotland, 58 years ago and received his education there in the Andersonian University and at the University of Glasgow. Coming to this country in 1888, he began his career with the electric light and power industry with the Edison Electric Light Company in New York. Dr. Eglin always took great interest in scientific matters, having served as president of Franklin Institute for five terms, as president of the National Electric Light Association and as a vice-president of the American Institute of Electrical Engineers.

JAMES E. KIRBY, a civil engineer for the Franklin Construction Company, Newark, N. J., died of heart disease on Feb. 2 at his home in Bloomfield, N. J. Mr. Kirby was born in South Carolina 43 years ago and was graduated from the Clemson Agricultural College in that state. He was a member of the American Society of Mechanical Engineers.

FENDALL G. WILSON, who built large parts of Northwestern railroads, died on Feb. 2 at his home in Minneapolis, Minn., of apoplexy.

R. P. MCINTOSH, assistant city engineer, San Francisco, died on Jan. 28 while in southern California on a vacation taken on recuperate from failing health brought on by overwork. Mr. McIntosh, who designed the O'Shaughnessy dam and numerous other structures built by the city on the Hetch-Hetchy project and elsewhere, was graduated from the University of California in 1908 and had been employed in the engineering department of San Francisco since 1912.

Construction Equipment and Materials

A Section Devoted to What the Manufacturer Is Doing for the Engineer and Contractor

Meter Company Installs Research Department

Believing that a research department would be valuable to the water industry, as well as to its own interest, the Pittsburgh Equitable Meter Co., Pittsburgh, Pa., has installed a complete research laboratory. Through this it is hoped to bring every aid of modern science into the design and manufacture of water meters and appliances. It will be among the functions of this department to determine proper materials to resist waters having a destructive action. It is believed also that there is much to be done in the way of improving water meter design.

The services of the research department are available to anyone in the water industry, and those in charge will answer any questions or assist customers in developing improved processes or eliminating sources of trouble. The laboratories are open for inspection to water department or company executives at all times.

Business Notes

DAVENPORT LOCOMOTIVE AND MANUFACTURING CORPORATION, Davenport, Iowa, announces that Charles Pasche, who has been secretary and treasurer of the company, has been elected president to succeed E. Parmly, Jr., who has severed his connections with the company.

MOTT & MCELRATH ENGINEERING CORPORATION, New York City, announces that it has recently been appointed sales representative for the buckets of the INDUSTRIAL BROWNHOIST COMPANY in New York, Connecticut, northern New Jersey and western Massachusetts.

T. M. GIRDLER has recently been elected president of the Jones & Laughlin Steel Corporation, Pittsburgh, Pa., succeeding Charles A. Fisher, who has retired. Mr. Girdler came to the organization in 1914 as assistant to the general superintendent of the works at Woodlawn, Pa. He has been vice-president in charge of operations since January, 1926.

ARMCO CULVERT MANUFACTURERS ASSOCIATION, Middletown, Ohio, announces the appointment of Dr. George Edgar Ladd as consulting geologist for the association. Dr. Ladd is an eminent educator and lecturer on geological subjects, having been for many years professor at the University of Missouri and later president of both the Oklahoma School of Mines and Metallurgy and the New Mexico College of Agriculture and Mechanical Arts.

MUNDY SALES CORPORATION, New York City, announces the following new agents: Herman M. Brown Company, Des Moines, Iowa; G. F. Lowe Company, Chicago, Ill.; Star Machinery Company, Seattle, Wash.; and the George Mueller Equipment Company, Milwaukee, Wis.

TIMKEN ROLLER BEARING COMPANY, Canton, Ohio, announces that an expenditure of $4,000,000 to be devoted to increasing the production facilities of the company has been authorized for 1928. A large part of the expansion program concerns the company's plant at Canton, where both the steel mill and the bearing manufacturing plant will be considerably enlarged.

DANIEL KENNEDY, president of the Kennedy Valve Manufacturing Company, of Elmira, N. Y., died on Jan. 14 at Hot Springs, Ark., after a short illness. He was in his eightieth year. Mr. Kennedy began business in 1877 in connection with the old Boston Dry Dock in the Erie Basin, Brooklyn, N. Y. As the business expanded, it was moved to Coxsackie, N. Y., in 1890 and to Elmira, N. Y., in 1907. Many valves and fire hydrant design features now accepted as standard originated with Mr. Kennedy.

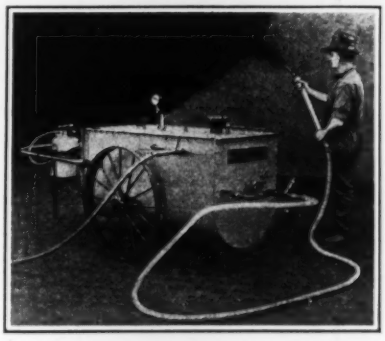
New Developments

Bituminous Coating Applied by New Air-Operated Gun

Spraying or shooting such materials as asphalt, tar and pitch is claimed to have been made possible and practicable by means of a new bitumen gun developed by the Quigley Furnace Specialties Company, 26 Cortlandt St., New York City. The design of the equipment is based on that of the company's refractory gun which has been used for shooting plastic refractories and in building or repairing furnace walls, baffles, etc.

The gun proper consists of a cast-iron cylinder containing a piston. The hot mixture is poured into the cylinder in front of the piston and forced out when air is admitted behind the piston. The air is not in contact with the material in the gun, nor is it used to form the spray, atomization being obtained by mechanical means. It is said that 15 cu.ft. of air a minute at 60 lb. pressure is sufficient for operation. The capacity of the cylinder is 15 gallons, enough to cover approximately 400 sq.ft. of surface. The gun mechanism inclosed in a steel housing mounted on wheels is shown in the accompanying illustration.

For operation two men are required, one at the nozzle, and another controlling the air supply and charging the gun. Temperature in the gun is regulated by a small self-contained kerosene burner. After the gun has been completely discharged, compressed air sends the piston back to the loading position ready for a fresh charge. An insulated metallic-type hose is used, in which it is claimed there is not over a 5 deg. drop in temperature for each 25 ft. of length with atmos-

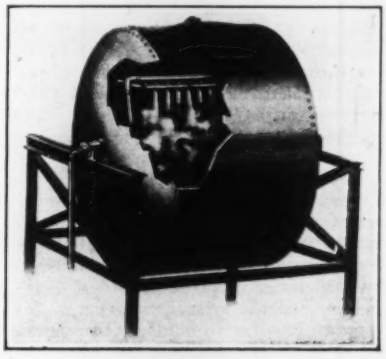


pheric temperature about 40 deg. F. The discharge end of the nozzle can be bent at any angle so as to reach otherwise inaccessible places. Special nozzles are available to meet special requirements. Before starting and when work stops, the hose is cleaned out with compressed hot air heated by a coil located in the housing.

Of the many uses recommended for the gun, the following are typical: Waterproofing foundations and walls of stone, brick or concrete; coating the interior of water tanks, vats, reservoirs, etc.; coating water, gas and oil pipe lines; and applying protective coatings to such structures as penstocks, bridge piers, abutments, dams, and retaining walls.

Rotary Asphalt Mixer Sprays Aggregate Under Pressure

Mixing asphalt under pressure is the principle applied by a machine being introduced by the American Fin-Mix Company, Chicago. It is known as the Finley rotary pressure mixer and was



originally developed some years ago and used locally in Georgia and one or two other southern states. It consists of a revolving drum containing no paddles, but into which is sprayed the asphalt through a manifold containing a number of openings. Uniformity, thorough mixing, uniform temperatures and greater strength are claimed for the resulting mixture. Perhaps the greatest advantage is the efficient impregnation of the aggregate with the asphalt. The mixer handles 3½, 5 or 7 tons of material per batch.

In operation the dry aggregate is introduced into the mixer in the usual way and is pre-mixed dry for two minutes. The asphalt is then introduced through the manifold which enters the mixer through a hollow trunnion, and is sprayed under 50 to 70 lb. pressure while the aggregate is cascading in the drum. The pressure is maintained while the mixing process is carried on for five minutes, making a total mixing time of seven minutes per batch. The machine is said to handle coarse aggregate for black base just as readily as it handles sand and fines.

Among the other advantages claimed are the following: Elimination of fat and lean spots in the mix, resulting in less chance of the pavement waving and pushing; large batches; reduction of dust nuisance around the plant; and speed in truck loading.

A New Porous Concrete for Slabs and Floor Fill

A new concrete product, known as Aerocrete and designed for use as a light building material, is being introduced in the United States by the Aerocrete Corporation of America, 51 East 42d St., New York. It is said that the product has been extensively used in

Europe for the last few years. Aerocrete obtains its light weight by virtue of the introduction of gas cells into the mass as contrasted to other lightweight building materials which use lightweight aggregate. Materials in this new concrete product are portland cement, fine aggregate and a small amount of powdered metallic aluminum, the latter producing the honeycomb effect. The product may be used either as a floor fill or as precast slabs for partitions, fireproofing, etc., as shown in the accompanying illustrations.

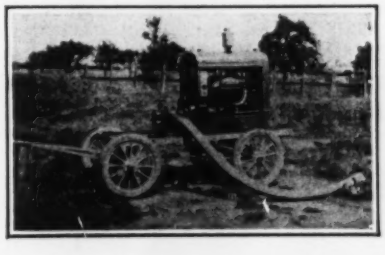
The weight of Aerocrete is said to be 55 lb. per cu.ft. In applying the material as floor fill or in pouring it in precast units, there is an expansion of the mass of from 40 to 50 per cent. From a chemical reaction produced by the water, powdered metallic aluminum and the portland cement, a gas is liberated

which causes the expansion. This expansion is completed in about an hour and a half when the initial set of the cement takes place. Following the initial set the top of the mass above the forms is removed by a screed and the waste taken back to the mixer to be used over again with the addition of a small quantity of cement. Aerocrete is claimed to give a perfect bond for a cement finish, and should a hardwood floor be used, nails may be driven directly into the Aerocrete. Besides its light weight, the advantages claimed for this product are permanence, sound insulation and heat insulation.

Portable Pump Unit for Fire or General Service Uses

A new pumping unit has recently been developed by Goulds Pumps, Inc., Seneca Falls, N. Y., consisting of a gear-type rotary pump close coupled by means of a flexible coupling to a gasoline power unit. The pump and engine are mounted on a four wheel trailer equipped with rubber tires and springs, front and rear. The pump is equipped with a relief valve and a discharge gate valve which may be threaded to suit various hose coupling threads. The suction is fitted for 4-in. hose.

Although intended primarily as a fire fighting unit, and useful as such on remote construction jobs, the pump is also suitable for general water supply service. Ball bearings are used throughout. The pump is fastened to the power unit frame by means of an open adapter casting which allows easy access to the



flexible coupling. The outfit will throw a standard 250 g.p.m. fire stream through a 1⅛-in. standard hose nozzle with a pressure of 100 lb. per sq.in. at the pump, using 100 ft. of 2½-in. hose.

Manufacturers and Trade Associations

Calendar

Annual Meetings

NATIONAL BRICK MANUFACTURERS ASSOCIATION, Danville, Ill.; Annual meeting, Atlantic City, Feb. 8-12.

COMMON BRICK MANUFACTURERS ASSN., Cleveland. Annual meeting, Washington, Feb. 13-17.

CHICAGO POWER SHOW AND MID WEST ENGINEERING EXPOSITION, Chicago, Feb. 14-18.

CONCRETE REINFORCING STEEL INSTITUTE, Chicago; Annual meeting, Biloxi, Miss., March 19-21.

AMERICAN WATERWORKS MFGRS. ASSOCIATION, New York City; Annual meeting, San Francisco, Calif., June 11-14.

New Publications

Electric Hoists—AMERICAN HOIST & DERRICK Co., St. Paul, Minn., has issued a new booklet on its high-speed electric hoists stressing the reasons why these hoists are especially adaptable to the work of the steel erector and the general contractor, and illustrating and describing the general features of both the silent chain and gear drive type.

A Fiftieth Anniversary—KENNEDY VALVE MFG. COMPANY, Elmira, N. Y., has published a catalog fittingly describing its 50 years of service since Daniel Kennedy started to make gate valves in a small shop in New York City in 1877. Illustrations of the company's original and present plant facilities together with the branches included in the booklet show the growth and present scale of operation.

Oil Burners and Acetylene Generators—ALEXANDER MILBURN Co., Baltimore, Md., has published two new bulletins illustrating and describing its oil burners and preheaters and its acetylene generators. Both bulletins include complete specifications for the various types and sizes of the equipment and include descriptive text and illustrations.

Power Shovels—UNIVERSAL POWER SHOVEL Co., Detroit, Mich., in a 23-p. catalog, describes its power shovel, crane and truck-crane models powered by Fordson engines. The catalog contains complete specifications and line drawings for the various models and in addition instructions on starting, operating and lubricating the machine. Several pages of illustrations showing various adaptations of the equipment in construction work also form a part of the booklet.

Business Side of Construction

Facts and Events That Affect Cost and Volume

January Industrial Building Same as Year Ago

Industrial building contracts of $40,000 and more reported by *Engineering News-Record* in January totaled $21,015,000, compared with $21,578,000 in January, 1927; the average contracts being $231,000 and $209,000, respectively. The table breaks these figures down into fourteen industrial classifications.

Gains in contract letting were reported as follows: chemical process, foods, cement and quarry products, and warehouses. Declines were in machinery and equipment manufactories, printing and binding, foundries, refrigeration and cold storage. Lettings in the public-utility group, the largest, were about the same as a year ago.

Total value of industrial building contracts for the United States in 1927 was $321,315,000 as against $311,665,000 for the year preceding, a gain of 2.8 per cent.

NUMBER AND VALUE OF INDUSTRIAL BUILDING CONTRACTS IN U. S. FOR JANUARY

(000 omitted in value)

	1928	1927
Public Utilities		
Value	$9,279	$9,987
Number of contracts	10	8
Chemical Process		
Value	1,225	725
Number of contracts	11	9
Food Products		
Value	1,264	530
Number of contracts	6	8
Automotive		
Value	2,555	1,497
Number of contracts	14	15
Machinery and Equipment		
Value	645	3,583
Number of contracts	4	20
Textiles and clothing		
Value	375	588
Number of contracts	6	7
Printing and Binding		
Value	107	1,150
Number of contracts	2	4
Steel Mills		
Value	80	160
Number of contracts	2	1
Cement and Quarry Products		
Value	250	100
Number of contracts	4	2
Foundries		
Value	202	750
Number of contracts	3	1
Refrigeration and Cold Storage		
Value	868	1,018
Number of contracts	9	12
Lumber and Woodworking		
Value	295	320
Number of contracts	2	2
Warehouses		
Value	1,200	385
Number of contracts	3	4
Unclassified		
Value	2,670	785
Number of contracts	15	10
TOTAL		
Value	$21,015	$21,578
Number of contracts	91	103

This Week's Contracts

Heavy construction contracts reported by *Engineering News-Record* in the week ended Feb. 9, with some comparisons, total as follows:

(In Thousands of Dollars, 000 Omitted)

Week Ended	Public	Private	Total
Feb. 9, 1928	$14,840	$41,527	$56,367
Feb. 2, 1928	18,360	30,303	48,663
Feb. 10, 1927	8,145	40,807	48,952
Jan. 1 to date:			
1928	107,948	195,066	303,01
1927	82,553	186,932	269,48[4]

[5]

E. N.-R. Index Numbers

Cost		Volume	
Jan. 1, 1928	203.90	December, 1927	319
Dec. 1, 1927	203.90	November, 1927	272
Jan. 1, 1927	211.50	December, 1926	188
Average, 1927	206.24	Average, 1927	263
Average, 1926	208.03	Average, 1926	228
1913	100.00	1913	100

Cement Price Decline Continues in Middle West—Lumber Firmer

The usual seasonal dullness is evident in the building materials market, with only slight week-to-week price changes.

Cement prices in the Middle West have declined at several points since Feb. 1. Cincinnati dealers quote $2.22 per barrel, a drop of 1c. from the price on Jan. 31. This change follows closely the reduction of 10c. per barrel at Wyandotte and Detroit, Mich.

Lumber appears firmer in the Middle West, especially since wholesale and retail stocks at yards in this section are below normal. In the Southwest, pine shipments from Louisiana and eastern Texas have been held to a minimum price for a year or more, because of competition with Douglas fir. Now, however, Douglas fir timbers, 3x12-in., 20-ft. lengths, at Seattle, are $22.50 per M ft., b.m., compared with $20 a week ago. This is the first advance in Northwestern fir since October, 1927, and is evidently the beginning of a buying movement for spring construction.

Foreign steel, entering at Galveston and Houston, has not affected the price at Dallas, which remains $4 per 100 lb. on shapes out of stock at warehouse. The Dallas price is 19 per cent higher than an average of warehouse quotations in ten cities, which report regularly to *Engineering News-Record*. The Pittsburgh mill price remains $1.85 per 100 lb.; on reinforcing bars, $1.90 to $1.95. Steel demand continues heavy.

Little Change Noted In Building Costs Since Last October

The American Appraisal Company cost indexes, covering four types of buildings in nine sections of the country, average 203.9 for December (latest calculation), which checks exactly with the *Engineering News-Record* Cost Index for that month. Values for October and November were practically the same as that for the last month of the year. The table gives the complete list for the fourth quarter; figures for the third quarter were given in *Engineering News-Record*, Oct. 20, 1927.

Brick buildings, with wood framing, continue to be the most expensive in all sections of the country except Texas and the Pacific Coast states. In these two sections frame-building costs are highest. Average costs by sections are as follows: Middle Atlantic states, 214.8; New York and northern New Jersey, 214.3; Pittsburgh district, 213.4; Central West, 208.8; New England, 208.6; Southeastern states, 207.8; Texas, 196.0; Pacific Coast states, 184.9; Northwestern states, 182.0.

INDEX NUMBERS BY SECTIONS

1927	Frame	Brick, Wood Frame	Brick, Steel Frame	Reinforced Concrete
New England				
October	209.5	223.0	200.0	209.5
November	209.5	222.0	199.5	207.5
December	208.5	220.5	199.5	206.0
New York and Northern New Jersey				
October	209.0	228.5	205.7	213.0
November	209.0	228.3	205.5	213.7
December	209.0	228.2	206.2	213.7
Middle Atlantic States				
October	211.3	231.0	207.7	208.0
November	211.7	230.7	207.3	207.7
December	211.0	231.0	208.3	208.7
Pittsburgh				
October	213.8	224.8	203.8	210.3
November	213.8	225.0	204.3	211.3
December	213.8	224.0	204.8	210.8
Central West				
October	209.2	218.5	199.6	210.0
November	209.0	218.7	199.6	209.5
December	208.5	218.0	199.6	209.0
Northwestern States				
October	187.0	195.0	184.0	184.0
November	187.0	195.0	184.0	184.0
December	186.0	194.0	184.0	184.0
Southeastern States				
October	210.8	220.5	197.5	202.3
November	210.8	220.5	197.5	202.3
December	210.8	220.5	197.7	202.3
Texas				
October	204.0	202.0	187.0	186.0
November	204.0	202.0	186.0	186.0
December	205.0	202.0	187.0	190.0
Pacific Coast States				
October	191.0	189.5	182.5	182.0
November	191.0	189.3	182.3	181.5
December	189.2	187.7	181.5	181.0
Average of Nine Districts				
October	205.0	214.7	196.4	200.6
November	205.1	214.6	196.2	200.4
December	204.6	214.0	196.5	200.6

Current Bond Offerings

		Interest Rate	Yield	Due
Alabama Great So. R.R. Co.	$5,206,000	4	4.15	Dec. 1, 1943
Detroit City Service Co.	1,300,000	6½	6.50	July 1, 1937
Greek Government	17,000,000	6	6.65	Feb. 1, 1968
Southern Gas Co. of Calif.	12,000,000	4½	4.80	May 1, 1968
Southern Pacific Co.	29,400,000	4½	.....	Mar. 1, 1968
Texas & Pacific Ry.	2,805,000	4½	4.10@4.25	Feb. 1, 1929-43

Equipment used to construct the Moffat Tunnel under James Peak in Gilpin and Grand counties, Colo., is valued at $993,000 by the Moffat Tunnel Commission, 1731 Arapahoe St., Denver, Colo. Bids for this material will be received until Mar. 1, 1928.